5-2008

An Evaluation of Quality Deer Management Programs in Tennessee

Christopher E. Shaw
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Christopher E. Shaw entitled "An Evaluation of Quality Deer Management Programs in Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.

Craig Harper, Major Professor

We have read this thesis and recommend its acceptance:

Gary Bates, Allan Houston, J. Mark Fly

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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AN EVALUATION OF QUALITY DEER MANAGEMENT PROGRAMS IN TENNESSEE

A Thesis Presented
for the
Master of Science Degree
The University of Tennessee, Knoxville

Christopher Edward Shaw
May 2008

DEDICATION

I dedicate this thesis to my parents who were there to watch me kill my first deer and have supported me throughout life.

ACKNOWLEDGEMENTS

Completion of this project would not have been possible without the help of several funding sources including the University of Tennessee, Department of Forestry Wildlife, and Fisheries, Hobart Ames Foundation, Sequatchie Forest and Wildlife, Quality Deer Management Association, Tennessee Wildlife Resources Agency, and Rocky River Farms.

I would like to thank my major professor, Dr. Craig Harper, for providing me the opportunity to work on a project involving white-tailed deer. The knowledge and experience gained in deer and habitat management are much appreciated, as well as the hunting trips. I would also like to thank committee members, Dr. Gary Bates, Dr. Mark Fly, and Dr. Allan Houston, for their assistance and support. Special thanks go to staff (Becky Stephens, April Griffin, Liz Didier) of the Human Dimensions Lab for their assistance with hunter surveying. I especially appreciate the patience and assistance provided by Becky throughout the project. Finally, I would like to thank Billy Minser for his conservation efforts and company on the occasional outdoor adventure.

Valuable statistical support was provided by several people, especially Ann Reed. Bob Muenchen and Cary Springer assisted with analysis of survey data. I would also like to thank Dr. Frank Van Manen for assistance with habitat analysis, and Dr. Arnold Saxton for answering statistical questions and assistance with other data analysis.

Logistical support was provided by several individuals. Mike Black provided help throughout the project and provided harvest data from Cumberland Plateau clubs. Several employees at Ames Plantation assisted with various aspects of this project, including James “Hooch” McDonald, Larry Teague, Beth Hanna, James Morrow**,** and Jimmy

Simons. Ben Layton compiled harvest data for Wildlife Management Areas and assisted with collection of harvest data. Bernie Swiney, Jim Evans, Jim Zimmerman, and several other Tennessee Wildlife Resources Agency personnel assisted with preparation of food plots and collection of biological data at check-in stations. I would also like to thank Dave Kincer and Bobby McKee for their assistance. Dwayne Estes provided assistance with plant identification. Several individuals assisted with collection of browse and food plot data including Greg Julian, Barry Baird, Dave Carpenter, and Tim Ward.

I would also like to thank fellow graduate students who provided assistance with the project and shared in hunting and fishing experiences. John Gruchy helped with collection of project data and shared in some enjoyable hunts. Kenton Brotherton and John Laux also shared in memorable outdoor experiences.

Finally, I would like express my appreciation to my parents and other family members for their support and encouragement.

ABSTRACT

Several properties within Tennessee were managed under a quality deer management (QDM) philosophy from 1998 to 2006. Harvest characteristics of three private properties and three Wildlife Management Areas (WMAs) were compared to determine effects on buck harvest rates and the age structure and sex ratio of the harvest. Average annual buck harvest decreased at most areas following antler restrictions and ranged from 55 to 68% of pre-QDM levels because younger bucks were protected. Although the raw numbers showed an increase in older-aged bucks harvested following antler restrictions, when calculated on a per hunter or per permit issued basis, statistical increases were not observed at all study areas. Regardless, hunters at each area felt QDM restrictions were working toward their goal and planned to apply to hunt that area the following season. Most hunters regarded themselves "somewhat knowledgeable" with QDM and considered it a sensible management philosophy. The majority of club hunters (55.5%) and plurality of sportsman license holders (36.9%) and WMA hunters (34.7%) favored a statewide limit of two bucks, and the majority of all hunters favored including does in the harvest and protecting young bucks from harvest.

The production and nutritional quality of twenty forages used in food plots and the effects of prescribed burning and understory fertilization on browse production in closed-canopy hardwoods one growing season after treatment were also evaluated. Crimson clover and a cool-season grain (wheat or oats) are recommended to address the mid-late winter stress period, and can be planted with arrowleaf clover to further extend forage availability in the spring. Warm-season annual forages (cowpeas, lablab, and soybeans) supplied forage during the late summer stress period when natural forage

quality is low. Ladino clover and chicory supplement production gaps of annual forages. Because of variable results among two sites and because the cost per pound of forage produced following fertilization exceeded $26 per pound, understory fertilization and prescribed fire in closed-canopy hardwood stands are not recommended for increased deer browse. Treatments providing increased sunlight through a reduction in percent canopy cover are much more effective and efficient in providing increased browse.

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INTRODUCTION

Quality deer management (QDM) involves three main constituents: deer, habitat, and hunters. This project measured the influence of management on these factors at seven study areas (Figure 1). Some or all parts of the research were conducted on a given area. Chapters of this thesis are divided based on these constituents. Chapter One evaluates harvest characteristics of four study areas under some type of antler restriction prior and post implementation. Chapters Two and Three evaluate habitat management practices that may be used in deer management programs, including an evaluation of several cool- and warm-season forages used in food plots, and the effects of prescribed burning and understory fertilization on browse production in closed-canopy hardwood stands. Chapter Four provides results from surveys sent to study area hunters and sportsman license holders to evaluate attitudes and satisfaction related to QDM.

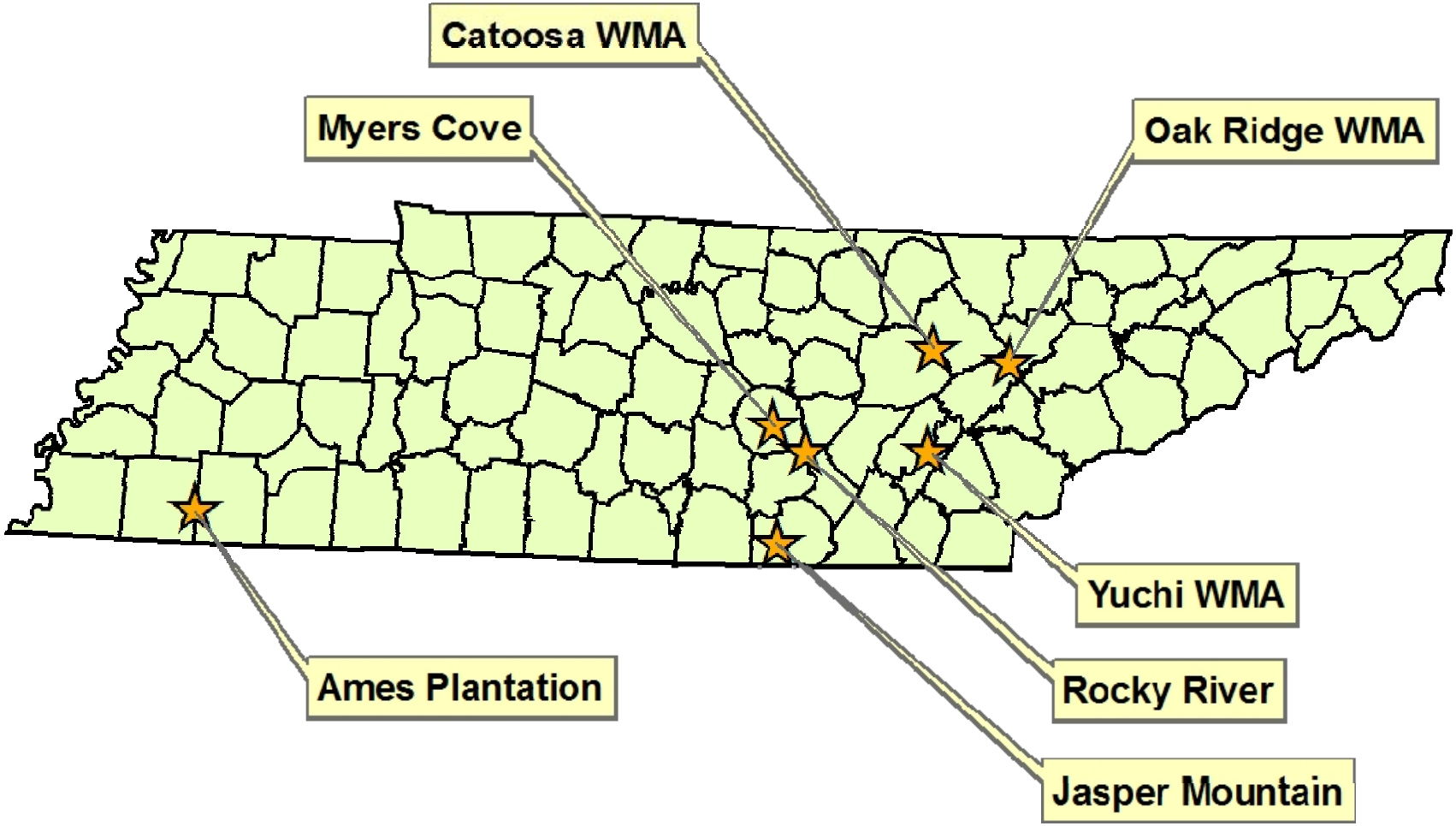

Figure 1. Map of Tennessee with location of study areas.

I. EFFECTS OF VARIOUS APPROACHES TO QUALITY DEER MANAGEMENT ON WHITE-TAILED DEER HARVEST CHARACTERISTICS

Abstract

Several properties within Tennessee were managed under a quality deer management (QDM) philosophy from 1998 to 2006. Harvest characteristics of three private properties and three Wildlife Management Areas (WMAs) were compared to determine effects on buck harvest rates as well as the age structure and sex ratio of the harvest. Average annual buck harvest decreased at most areas following antler restrictions and ranged from 55 to 68% of pre-QDM levels because younger bucks were protected. A change in the composition of the ≥1.5-year-old buck harvest was observed at all areas. Yearling bucks still comprised a relatively high percentage (15%) of the ≥1.5-year-old buck harvest at Catoosa WMA, where the harvest goal was for bucks to reach at least 2.5 years of age. Yearlings were well protected (8% of the ≥1.5-year-old buck harvest) at Ames Plantation. However, 2.5-year-old bucks still comprised a high percentage (41%) of the ≥1.5-year-old buck harvest, which was not desirable as the harvest goal at Ames Plantation was to allow bucks to reach at least 3.5 years of age. Raw numbers showed an increase in the number of older-aged bucks harvested on all areas following antler restrictions, but when calculated on a per hunter or per permit issued basis, statistical increases were not observed at all study areas. An increase in the ≥2.5- (0.95 bucks per 100 hunters pre-QDM vs. 1.98 bucks per 100 hunters post-QDM) and ≥3.5-year-old (0.19 bucks per 100 hunters pre-QDM vs. 0.44 bucks per 100 hunters post-QDM) buck harvest occurred at Catoosa WMA. The ≥3.5-year-old (4.63 bucks per 100 hunters pre-QDM vs. 22.10 bucks per 100 hunters post-QDM) buck harvest also increased at Ames Plantation, but no changes in the ≥2.5-year-old buck harvest was

detected for Oak Ridge (2.35 bucks per 100 permits pre-QDM vs. 3.51 bucks per 100 permits post-QDM) or Yuchi (3.54 bucks per 100 permits pre-QDM vs. 4.22 bucks per 100 permits post-QDM) WMAs. Percentage of does in the total harvest remained similar at Catoosa (31.9% pre-QDM vs. 33.1% post-QDM) and Yuchi (52.3% pre-QDM vs. 62.4% post-QDM) WMAs, while it increased at Oak Ridge WMA (41.3% pre-QDM vs. 56.4% post-QDM) and Ames Plantation (42.2% pre-QDM vs. 73.9% post-QDM) as a result of increased doe harvest recommendations. Percentage of buck fawns in the antlerless harvest was similar following QDM and exceeded 10% for all areas. Management recommendations include basing antler restrictions on characteristics of deer in the area and using antler restrictions in conjunction with age restrictions to ensure adequate protection of younger bucks. This will also ensure hunters are not penalized when a buck reaches the harvestable age, while antler size may not be above the restrictions. Educational efforts to help hunters age deer on the hoof and to reduce the harvest of buck fawns on these areas are also needed. Collection of observation data by hunters and infrared-triggered camera surveys would help WMA managers track the progress of programs. Finally, success of programs should also be gauged based on attitudes and satisfaction of hunters on an area.

Introduction

Quality deer management (QDM) is a management strategy that focuses on managing deer herds in a biologically and socially sound manner in accordance with the existing habitat conditions. QDM stresses management of deer populations within the nutritional carrying capacity of the surrounding areas and thus has been used to

ameliorate problems associated with overpopulation and skewed sex ratios. Typically, an age or antler restriction that protects younger bucks is coupled with an appropriate doe harvest to even sex ratios and increase the age structure of the herd.

Quality deer management has been incorrectly referred to as "trophy" deer management. Interest in trophy deer management was observed by personnel with the Tennessee Wildlife Resources Agency (TWRA) in the 1980's (Hastings and Pelton 1988). Results from past attempts of implementing antler restrictions on public lands in Tennessee have been mixed.

Following the survey by Hastings and Pelton (1988), TWRA's first attempt at implementing antler restrictions on public land was initiated in the 1989-90 deer season at Natchez Trace Wildlife Management Area (WMA) in Carroll and Henderson counties. The program at Natchez Trace was given five years to produce results. A high percentage of yearling bucks in the harvest during the first two years of the program and harvest of yearling deer on adjacent properties were suspected as reasons why the number of 2.5-year-old bucks did not increase in the harvest (Ben Layton, TWRA biologist, personal communication). However, the goal of providing an area for hunters to participate in a QDM program was successful as a survey of 1991-94 Natchez Trace quota hunt applicants showed over 70% support for QDM on Natchez Trace.

In 1994, TWRA indicated Giles county hunters were familiar with QDM and would support a QDM program. A multi-wave mail survey was used to determine whether local hunters and landowners would be supportive (at least 70% minimum) of QDM in Giles, Lincoln, and Maury counties (Fly and Stephens 1997). While 69% of hunters surveyed were supportive of QDM, only 45% of landowners were supportive of a

QDM program. Because there was not enough support, TWRA did not implement the QDM program, but it was noted that lack of support from landowners may have resulted from a lack of familiarity with QDM.

Since 1998, several tracts of private land and several public lands (WMAs) within Tennessee have been managed following the QDM philosophy. However, an evaluation of the effects of these programs on harvest characteristics has not been conducted. Three private properties and three WMAs were evaluated in this study. An antler restriction to protect younger bucks was implemented on each, but they differed in approaches to antlerless harvest. Specific objectives of this study were to:

1) determine effect of various QDM restrictions and recommendations on buck harvest rates;

2) determine effect of various QDM restrictions and recommendations on age structure of buck harvest;

3) determine effect of various QDM restrictions and recommendations on sex ratio harvested.

Study Areas

Ames Plantation

Ames Plantation is a 18,653-acre property located within the Coastal Plain physiographic province in Fayette and Hardeman County, Tennessee. Deer hunting at Ames followed statewide regulations historically with permits issued to eligible hunters through the 2000 season. Biological data on all deer killed were collected beginning with the 2002-03 season when 316 permits were issued. During the 2003-04 season, Ames Plantation Hunting Club was established with 52 hunters. Data collection continued and was combined with the 2002-03 data to establish antler restrictions that would protect

bucks 2 ½ years old and younger (Table 1; all tables are located in appendices following each chapter). During the 2004-05 season, QDM guidelines were implemented that included a doe harvest quota (180) and a 110-inch gross score (following the Boone and Crockett Club) requirement (or minimum age of 5 ½ years) for all bucks harvested. Membership in the club grew to 125 hunters in the 2006-07 season, when a 120-inch gross score requirement (or minimum age of 4 ½ years) for bucks was implemented.

Rocky River and Jasper Mountain Hunting Clubs

Rocky River and Jasper Mountain Hunting Clubs are located within the Cumberland Plateau physiographic province, a heavily forested region in Tennessee. Rocky River is a 4,800-acre property in Sequatchie, Van Buren, and Warren County and operated under a QDM program beginning in 2000. Jasper Mountain is a 8,588-acre property located in Marion County with a QDM program starting in 2001. Biological data were collected on all deer killed on these areas at check-in stations located at each area. A gross score of 100 inches was used as an antler restriction to protect bucks 2 ½ years old and younger on these properties.

Catoosa Wildlife Management Area

Catoosa WMA is a 79,740-acre property located within the Cumberland Plateau physiographic province in Cumberland and Morgan County, Tennessee. Deer hunting has occurred at Catoosa WMA since 1955, and data were collected from deer since the first hunting seasons to determine average characteristics among sex and age classes. Both quota and non-quota (open) hunts are held on the area, with biological data collected at two stations (Genesis and Bicolor) located on the area. Beginning with the 1998 hunting season, Catoosa managers and biologists decided to implement a QDM program after

hunter participation declined as hunting opportunities increased on private lands. From data collected since 1955, it was decided to implement a 4-point on one side antler restriction to protect yearling bucks. The recommended doe harvest varies and is determined each year.

Oak Ridge Wildlife Management Area

Oak Ridge WMA is a 37,000-acre property located within the Ridge and Valley physiographic province in Roane and Anderson County, Tennessee. Deer hunting has occurred on Oak Ridge WMA since 1985 with the exception of the 2001 season when Oak Ridge was closed for national security reasons. The area is open to public hunting with hunters selected through a random drawing to hunt on the area during three hunts held each year. These hunts are held in November and December and each lasts two days. Because of safety issues, Oak Ridge is divided into archery-only hunting zones and gun hunting zones, and slightly less than half of the hunters selected are assigned to the gun hunting zones. Through the area's one check-in station, data have been collected on 99 percent of all deer harvested. In 2003, a QDM program was implemented requiring antlered bucks have at least four one-inch antler points on one side of the rack or have an outside antler spread of 15 or more inches to be legal for harvest with a goal of protecting yearling bucks.

Yuchi Wildlife Management Area

Yuchi Refuge at Smith Bend is a 2,364-acre property located within the Ridge and Valley physiographic province in Rhea County, Tennessee. Prior to 2000, the area was in private ownership and deer hunting was allowed during statewide deer season with no public access. In 2000, Yuchi Refuge was purchased by the Tennessee Wildlife

Resources Agency and has been open to public hunting since. Hunters are selected through a random drawing to hunt on the area during the six quota hunts held each year, with the exception of one hunt that is open to handicapped hunters only. The hunts are held from September to November and each hunt lasts for two days. Through the area's one check-in station, data have been collected on 99 percent of all deer harvested since 2000. A QDM program was established in 2003. Under this program, the area has an antlered buck harvest restriction that is the same as for Oak Ridge WMA to protect yearling bucks.

Materials and Methods

Sex and age were recorded for deer killed at all study areas. Jawbones were aged using the tooth replacement and wear method (Severinghaus 1949) by TWRA personnel at WMAs and technicians and managers at clubs.

To evaluate the QDM programs, harvest characteristics from a similar number of years immediately before and after the initial season of QDM were compared, but there were exceptions for some areas. Comparisons of harvest pre- and post-QDM were not possible for clubs located on the Cumberland Plateau because QDM programs began with the establishment of the clubs. Although no before and after comparisons were possible for Plateau clubs, harvest characteristics post-QDM are presented. National security concerns in 2001 resulted in no harvest which altered "normal" deer harvest patterns at Oak Ridge WMA in years immediately prior to the start of the QDM program, so harvests from 1998-2000 were compared to 2004-2006. Only two years of pre-treatment

data were available at Yuchi WMA, so these data were compared to data for three years after the initial season of restrictions.

Comparisons of harvest characteristics at each site were made using a repeated measures ANOVA by variable and by study area. Variables included average buck (all age classes) and doe harvest, percentage of buck fawns in the antlerless harvest, percentage of does in the total harvest, ≥2.5-year-old buck harvest, and ≥3.5-year-old buck harvest. Count variables (total buck, ≥2.5- and ≥3.5-year old buck, and doe harvest) were standardized based on hunter pressure to assess changes in harvest characteristics. For Ames Plantation, variables were divided by the number of hunters for each year. Because Catoosa WMA had a mixture of quota and nonquota hunts, hunter estimates collected by TWRA personnel at this area were used to standardize variables. For Oak Ridge and Yuchi WMA, the total number of quota permits issued each year was used for standardizing variables. Estimates of hunter success at Oak Ridge and Yuchi WMA should be viewed as conservative because all hunters may not show up on each hunt. The percentage of hunters actually participating in each quota hunt at Oak Ridge and Yuchi WMA was assumed to be similar across years. To normalize the variables analyzed with a repeated measures ANOVA, variables expressed as a percent were arcsin transformed for analysis, while count variables were log transformed for analysis. When there was a violation of the normality and/or variance (>3-fold difference of standard deviations between pre- and post-QDM comparisons) assumptions of the ANOVA, rank transformations were used.

Proportions of 1.5-, 2.5-, and ≥3.5-year-old bucks in the ≥1.5-year-old buck harvest were compared using Pearson Chi-Square tests with adjusted residuals of +/- 2.0

used to indicate deviations. Significant changes in 2.5- and 3.5-year-old percentages are mostly explained mathematically (by removal of 1.5-year-old bucks from the harvest following antler-based restrictions) and may lead to incorrect conclusions (Demarais et al. 2005). Therefore, the harvest of ≥2.5- and ≥3.5-year old bucks was also used to evaluate changes in the buck harvest.

Results

Ames Plantation

The average annual buck harvest per hunter at Ames Plantation in years prior to QDM (2002-2003) was similar ($F_{1,2}$=0.23,P=0.72) to years following (2005-2006) the initial season of QDM in 2004 (Table 2). The percentage of buck fawns in the antlerless harvest was also similar ($F_{1,2}$=8.00,P=0.11), while the percentage of does in the total harvest increased ($F_{1,2}$=21.95,P=0.04) from 42% ($\bar{x}$ =84 does) to 74% ($\bar{x}$ =209 does). However, the doe harvest per hunter was similar ($F_{1,2}$=1.86,P=0.31). Age composition of the ≥1.5-year-old buck harvest differed (Pearson Chi-Square=103.52, df=2, P<0.01) before and after restrictions because of a decrease in percentages of 1.5-year-old bucks (63.1 to 8.3%) and an increase in percentages of ≥3.5-year-old bucks (7.1 to 51.0%). Percentage of 2.5-year-old bucks in the ≥1.5-year-old buck harvest was 29.8% and 40.6% before and after restrictions, respectively. The ≥2.5-year-old buck harvest per hunter ($F_{1,2}$=0.41,P=0.59) was similar, but the ≥3.5-year-old buck harvest per hunter ($F_{1,2}$=31.42,P=0.03) increased following restrictions.

Rocky River and Jasper Mountain Hunting Clubs

Percentage of 1.5-year-old bucks in the ≥1.5-year-old buck harvest at Rocky River ranged from 0% in 2000 to 14% in 2003, while percentage of 2.5-year-old bucks ranged from 64% in 2000 to 0% in 2003. The percentage of does in the total harvest at Rocky River ranged from 64% in 2002 to 74% in 2003. Percentage of buck fawns in the antlerless harvest ranged from 14% in 2002 to 2% in 2003.

At Jasper Mountain, no yearling bucks were harvested from 2001 to 2003. Percentage of 2.5-year-old bucks in the ≥1.5-year-old buck harvest ranged from 29% in 2002 to 60% in 2001. The percentage of does in the total harvest at Jasper Mountain ranged from 14% in 2001 to 64% in 2003, and the percentage of buck fawns in the antlerless harvest ranged from 50% in 2001 to 3% in 2003.

Catoosa Wildlife Management Area

Average annual buck harvest per hunter at Catoosa WMA decreased ($F_{1,14}$=11.67,P<0.01) from 0.039 bucks per hunter in years prior to QDM (1990-1997) to 0.028 bucks per hunter in years following (1999-2006) the initial season of QDM in 1998 (Table 3). Percentage of buck fawns in the antlerless harvest ($F_{1,14}$=1.89,P=0.19) and percentage of does in the total harvest ($F_{1,14}$=0.18,P=0.67) was similar. The doe harvest per hunter was similar ($F_{1,14}$=3.67,P=0.08). Age composition of the ≥1.5-year-old buck harvest changed (Pearson Chi-Square=1061.90, df=2, P<0.01) as a result of a decreased percentage of 1.5-year-old bucks (70.2 to 15.1%) and increased percentages of 2.5- (23.7 to 66.3%) and ≥3.5-year-old bucks (6.1 to 18.6%). The ≥2.5-year-old buck harvest per hunter ($F_{1,14}$=29.60,P<0.01) and ≥3.5-year-old buck harvest per hunter ($F_{1,14}$=26.39,P<0.01) increased.

Oak Ridge Wildlife Management Area

The average annual buck harvest per quota permit at Oak Ridge WMA decreased ($F_{1,4}$=7.75,P=0.05) from 0.070 bucks per permit in years prior to QDM (1998-2000) to 0.048 bucks per permit in years following (2004-2006) the initial season of QDM in 2003 (Table 3). Percentage of buck fawns in the antlerless harvest was similar ($F_{1,4}$=3.89,P=0.12) before and after QDM. The percentage of does in the total harvest increased ($F_{1,4}$=19.82,P=0.01) from 41% ($\bar{x}$ =145 does) to 56% ($\bar{x}$ =182 does), but the doe harvest per permit was similar ($F_{1,4}$=2.27,P=0.21). A decrease in the percentage of 1.5-year-old bucks (60.3 to 7.8%) in the ≥1.5-year-old buck harvest and increase in the percentage of 2.5- (30.7 to 68.4%) and 3.5-year-old bucks (8.9 to 23.9%) caused changes (Pearson Chi-Square=234.95, df=2, P<0.01) in the age structure of the buck harvest at Oak Ridge WMA following QDM. The ≥2.5-year-old buck harvest per permit ($F_{1,4}$=3.34,P=0.14) and ≥3.5-year-old buck harvest per permit ($F_{1,4}$=3.83,P=0.12) was similar.

Yuchi Wildlife Management Area

Average annual buck harvest per quota permit ($F_{1,3}$=17.55,P=0.07) decreased from 0.209 bucks per permit in years prior to QDM (2001-2002) to 0.108 bucks per permit in years following (2004-2006) the initial season of QDM in 2003 (Table 3). Percentage of buck fawns in the antlerless harvest ($F_{1,3}$=9.00,P=0.06), percentage of does in the total harvest ($F_{1,3}$=2.44,P=0.22), and doe harvest per permit ($F_{1,3}$=7.59,P=0.07) at Yuchi WMA was similar. Age composition of the ≥1.5 year-old buck harvest changed (Pearson Chi-Square=68.25, df=2, P<0.01) following restrictions, primarily due to a decreased percentage of 1.5-year-old bucks (75.7 to 10.9%) and increased percentage of

2.5-year-old bucks (19.8 to 75.0%). The ≥2.5 year-old buck harvest per permit ($F_{1,3}$=0.49,P=0.53) and ≥3.5 year-old buck harvest per permit ($F_{1,3}$=0.00,P=0.98) was similar.

Discussion

It is important for managers and hunters to have realistic expectations when implementing QDM programs, as meaningful results may require five years or more (Hamilton et al. 1995b) and certainly vary among properties. This is especially important when motivations for participating in programs include the harvest of larger-antlered (normally older) bucks. The QDM program at Catoosa WMA has been in effect longer (nine years including the initial season) than programs at the other study areas. Although the average annual buck harvest declined following restrictions, the harvest of ≥2.5 year-old bucks increased. An increase in the harvest of ≥3.5 year-old bucks was observed at Ames Plantation, even though restrictions were only in place for three years.

Hunters should be informed that increases in the harvest of quality bucks is often accompanied by a decrease in the average annual buck harvest following QDM restrictions (Hamilton et al. 1995b, Demarais et al. 2005). Average annual buck harvest per hunter at Ames Plantation following restrictions was 68% of harvest before restrictions. Average annual buck harvest for Catoosa, Oak Ridge, and Yuchi WMAs post QDM were 55, 68, and 59% of pre-QDM levels. Demarais et al. (2005) reported total buck harvest on WMAs in Mississippi following a statewide antler regulation that protected bucks with <4 (total) antler points was 60% of harvest before the regulation. Combined with negative biological effects from this regulation, the inadequate increase

in the harvest of older males led Demarais et al. (2005) to conclude alternatives were needed to improve the buck age structure on these areas. While the return on passing up young bucks is not 100% (Van Brackle and McDonald 1995), hunters will likely be satisfied with a lowered total buck harvest when there is an increased harvest of older bucks. Hunters on the WMAs and clubs surveyed in this study indicated they were satisfied with the QDM regulations at each study area (see Chapter Four).

Composition of the ≥1.5-year-old buck harvest changed following restrictions at all areas, but corresponding increases in the numbers of ≥2.5- and ≥3.5-year-old bucks in the harvest were only observed at Catoosa WMA and Ames Plantation. Some areas still had relatively high percentages of deer killed under the targeted age classes. For example, almost half (49%) the bucks harvested at Ames Plantation were under 3.5 years old, and most of those were 2.5-year-old bucks. Because a gross Boone and Crockett score restriction was used to protect 2.5-year-old bucks and allow harvest of 3.5-year-old bucks at Ames Plantation, some hunters were not adequately familiar with field judging antler scores. As expected, increasing the minimum requirement to a 120-inch gross score (or 4.5 years old) in the 2006-07 season lowered the percentage of 2.5-year-old bucks in the ≥1.5-year-old buck harvest (47% in the 2005-06 season and 32% in the 2006-07 season). With the 120-inch gross score requirement at Ames Plantation, and as hunters become more familiar with field judging body and antler characteristics, harvest of younger bucks should decline significantly in the future.

The goal of antler restrictions is to increase the buck age structure. Antler restrictions should give hunters a clue to buck age depending on the antler characteristics per age class. If antler restrictions allow bucks to be harvested under the identified age,

then changes are needed. Certainly, an age restriction protecting young bucks is ideal, but identifying the age of live bucks is a foreign concept and exceedingly difficult for many hunters. Educational efforts to enable hunters to age live bucks are needed.

A relatively high percentage of 1.5-year-old bucks in the ≥1.5 year-old buck harvest at some WMAs with point and/or spread restrictions was observed. Fifteen percent of the ≥1.5 year-old buck harvest at Catoosa WMA was comprised of 1.5-year-old bucks in years following antler restrictions, compared to 8 and 11% at Oak Ridge and Yuchi WMA, respectively, which combined a point restriction with a spread restriction. Based on data collected in pre-treatment years, a four point on one side of the antler restriction would have protected 89 and 91% of 1.5-year-old bucks on Yuchi and Oak Ridge WMA, respectively. The spread restriction (outside antler spread of 15 or more inches to be legal) would have protected virtually all 1.5-year-old bucks

Although harvest of ≥2.5-year-old bucks increased at Catoosa WMA, changes in restrictions at all WMAs where point restrictions are used may protect more 1.5-year-old bucks and prevent negative biological impacts to the herd. Point restrictions have been shown to reduce antler size of a cohort in some regions by selectively harvesting yearlings with more than four points (Strickland et al. 2001). Point restrictions are biologically sound where the yearling buck age class does not produce a given number of points and where the intention is to allow 2.5-year-old bucks to be harvested. However, on most areas, a sizeable proportion of yearling and 2.5-year-old bucks produce six to eight points, or more, and a point restriction leads to cohort antler degradation or "high-grading."

Increases in the percentage of does in the total harvest while protecting younger bucks can help even sex ratios and lower the herd below nutritional carrying capacity. Minimizing the harvest of buck fawns can also help even sex ratios as a large proportion of orphaned buck fawns may not disperse (Holzenbein and Marchinton 1992). Hamilton et al. (1995a) noted the percentage of buck fawns in the antlerless harvest was reduced by almost half (16.7% to 9.7%) in the coastal plain of South Carolina after hunters were informed how to distinguish between does and buck fawns.

Educational efforts at clubs likely contributed to a high percentage of does in the total harvest and low harvest of buck fawns. Although no statistical comparisons were made, members of clubs located on the Cumberland Plateau (Rocky River and Jasper Mountain) increased the doe harvest while minimizing the number of buck fawns killed. Educational efforts by the club manager resulted in the lowest percentage of buck fawns in the antlerless harvest of all study areas. Infrared-triggered camera census data collected at Rocky River indicated declines in herd density from 2000 (42 deer/square mile) to 2003 (28 deer/square mile) and increases in the buck to doe ratio (1 buck:3.5 does and 1 buck:1.9 does, respectively). Observation data collected by hunters at Jasper Mountain indicated improvements in sex ratios from 2001 (1 buck:3.3 does) to 2003 (1 buck:2.8 does).

After doe harvest was strongly encouraged by club managers, members of Ames Plantation Hunting Club met and exceeded doe harvest goals, which increased the percentage of does in total harvest. This resulted in improved sex ratios as measured by observation data collected by hunters at Ames from 2004 (1 buck:1.99 does) to 2006 (1 buck:1.76 does). Achieving doe harvest goals at Ames was facilitated by the creation of

Unit L by TWRA during the 2004 season (Figure 2, located in the appendix). Unit L is a deer management unit allowing liberal harvest of antlerless deer.

Generally, WMAs evaluated in this study had a relatively low percentage of does in the total harvest and a high percentage of buck fawns in the antlerless harvest when compared to clubs. Only Oak Ridge WMA showed increases in the percentage of does in the total harvest in post-QDM years. Increases in the number of does in the total harvest may not necessarily occur after QDM is implemented, as doe harvest may fluctuate according to the nutritional carrying capacity and objectives of the manager. In fact, in some areas, there may be a relatively small doe harvest if the population is desired to increase, or when the population has been lowered and stabilized after an intensive effort to reduce deer density. **To ensure a balanced sex ratio, percentage of bucks in the harvest should not exceed the percentage of does unless a herd increase is desired**. Educational efforts can increase the success of these programs by decreasing the percentage of buck fawns in the antlerless harvest. This can be accomplished by including information on distinguishing buck fawns from does at check-in stations, in the hunting regulations, and on permits mailed to hunters.

Along with proper herd management, quality deer management involves proper habitat management and herd monitoring. Unless the herd is below the nutritional carrying capacity for an area, changes in biological parameters (such as average weights, antler size, lactation rates) will not be observed just by implementing antler restrictions. Improvements in habitat (timber harvesting, food plots) may also be needed to realize the full potential of the herd. Habitat conditions at Yuchi WMA suggested a need for an even

higher doe harvest to keep the herd below nutritional carrying capacity of this property. This would, of course, also improve the sex ratio.

Management Recommendations

Because the goal of antler restrictions is to improve buck age structure, hunters should not be penalized when the age of harvested bucks meet the goal of the QDM program, but antler size does not. Regardless of the type of antler restriction (point, spread, or gross score), age restrictions should also be implemented based on the goals of the program. This necessitates educating hunters on how to age deer on the hoof. Educational seminars or meetings for hunters can provide an avenue for hunter education.

Because restrictions and harvest goals suitable for one region may not be suitable for another, managers should use characteristics of the deer in their area to determine appropriate management strategies and adapt these strategies as habitat conditions and herd characteristics change. When data indicate a high percentage of younger bucks are harvested within the restriction, the restriction should be changed. In addition, if antler restrictions preclude mature bucks from being harvested, the restriction should change. For example, the addition of a spread restriction at Catoosa WMA would allow harvest of older bucks that may not have four antler points on one antler (e.g., a 4.5-year-old 6-pointer).

Depending on herd density, percentage of does in the harvest should generally exceed percentage of bucks in the harvest to balance sex ratios. Habitat conditions at Yuchi WMA suggest an increased doe harvest is needed to lower herd densities below nutritional carrying capacity of the area.

Selective-harvest criteria obviously affect harvest characteristics; therefore, collection of observation data (deer sightings by hunters) is needed to help track progress of the program. Hunters collecting observation data at clubs allowed managers to monitor changes in sex ratios and track the progress of the QDM program. Collecting observation data at WMAs would provide additional information for managers to track the progress of the program.

Monitoring changes in the herd with infrared-triggered camera surveys also allows managers to gauge management successes that may not be realized with harvest data. For example, older bucks may be present and photographed on a property, but may not be harvested because of hunter experience or inadequate hunter pressure. Hunter pressure affects harvest rates and managers have to identify appropriate quotas that result in quality hunting experiences while still achieving management goals for the deer herd.

Along with deer sightings and biological data collected on an area, success in programs should also be gauged by hunter satisfaction levels. Restrictions at Oak Ridge WMA were discontinued for the 2007 season, which will likely be discouraging to some hunters given the support for the program. Surveys of Oak Ridge WMA hunters conducted two years after the program began indicated 87% felt the restrictions were working toward their goal, and 90% of the hunters planned to apply to hunt at Oak Ridge the following season (see Chapter Four). Additionally, hunters ranked the quality of hunting at Oak Ridge WMA higher than hunting in surrounding counties (Roane and Anderson). Because club and WMA hunters knowledgeable with QDM were generally favorable to this philosophy, managers should refine management strategies (educational efforts, changes in doe harvest levels or antler restrictions) when biological goals are not

met in QDM programs. This will ensure interested hunters have access to areas managed under a QDM philosophy.

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Literature Cited

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Appendix

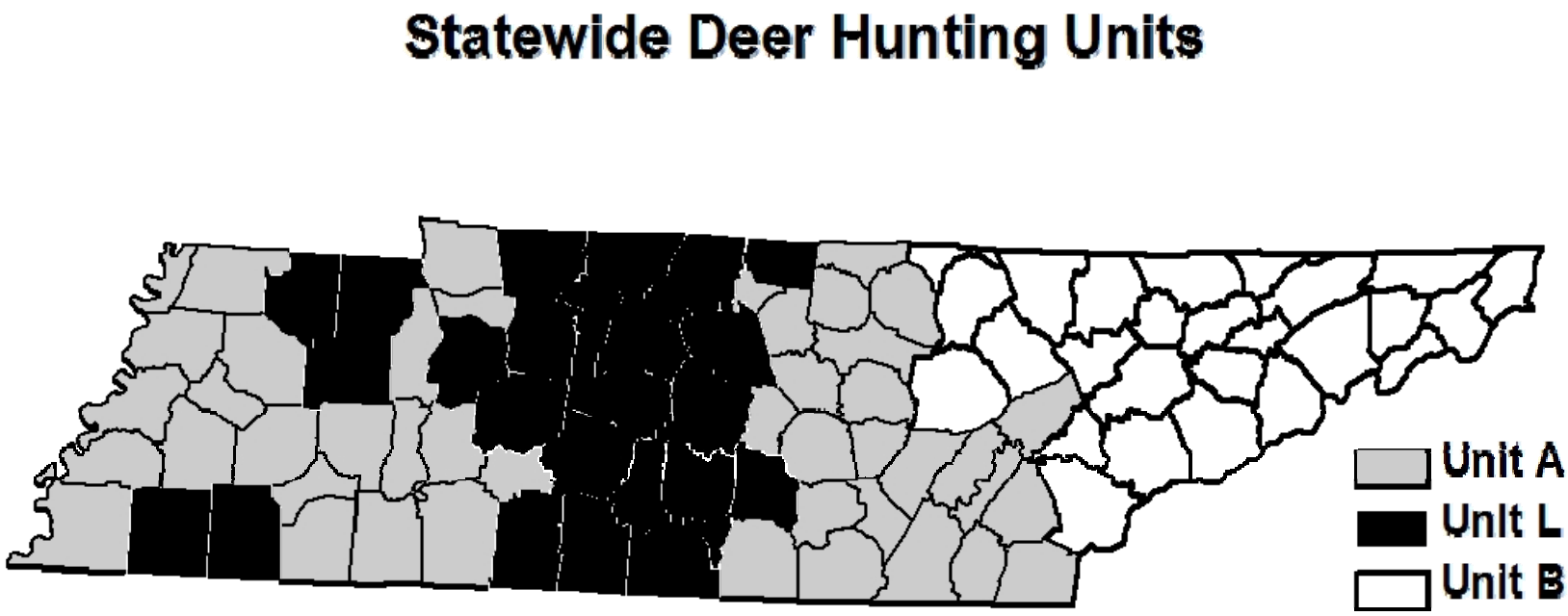

Figure 2. Map of Tennessee showing deer management units during the 2004-05 hunting season.

Table 1. Antler restrictions and their potential to protect 1.5- and 2.5-year-old bucks from harvest during the 2002-03 and 2003-04 hunting seasons at Ames Plantation, Fayette and Hardeman Counties, Tennessee.

Regulation	Age class	% bucks protected
three points on one antler minimum	1.5	54
	2.5	8
four points on one antler minimum	1.5	86
	2.5	32
spread minimum (15 inch)	1.5	100
	2.5	59
beam length minimum (15 inch)	1.5	95
	2.5	16
beam length minimum (16 inch)	1.5	97
	2.5	28
beam length minimum (17 inch)	1.5	100
	2.5	46
beam length minimum (18 inch)	1.5	100
	2.5	76
gross score (110 B&C)	1.5	100
	2.5	85
gross score (115 B&C)	1.5	100
	2.5	85
gross score (120 B&C)	1.5	100
	2.5	92

Table 2. Average harvest characteristics[a] (SE) on Ames Plantation before and after QDM.

Period	Years[b]	Total $\bar{x}$ (SE)	Bucks $\bar{x}$ (SE)	% of total	Does $\bar{x}$ (SE)	% of total	Buck fawns in antlerless harvest %	≥2.5 buck $\bar{x}$ (SE)	≥3.5 buck $\bar{x}$ (SE)
Pre	2002-2003	1.85(1.02)	1.00(0.48)	57.8	0.83(0.53)	42.2	18.1	0.30(0.14)	0.05(0.01)
Post	2005-2006	2.59(0.58)	0.68(0.20)	26.1	1.90(0.38)	73.9	11.0	0.40(0.12)	0.22(0.03)
			P=0.72		*P*=0.31	*P*=0.04	*P*=0.11	*P*=0.59	*P*=0.03
			Acres per buck		Acres per doe			Acres per ≥2.5 buck	Acres per ≥3.5 buck
Pre	2002-2003		176(65)		228(34)			590(218)	3945(2255)
Post	2005-2006		258(47)		90(8)			437(79)	760(16)

[a]**With the exception of acres per deer killed, count variables were standardized on a per hunter basis** to account for differences in hunter numbers across years: 316 in 2002, 52 in 2003, 67 in 2004, 100 in 2005, 125 in 2006. Significance values of tests for before and after comparisons are indicated under columns of variables tested. All variables were not tested to lower Type I error and because of the relatedness of some variables.

[b]Antler restrictions (110-inch gross score minimum or 5.5 years old) implemented in 2004 and changed to 120-inch (or 4.5 years old) in 2006.

Table 3. Average harvest characteristics (SE) on Wildlife Management Areas in Tennessee before and after QDM.

Site[a]	Period[b]	Years[c]	Total $\bar{x}$ (SE)	Bucks $\bar{x}$ (SE)	% of total	Does $\bar{x}$ (SE)	% of total	Buck fawns in antlerless harvest %	≥2.5 buck $\bar{x}$ (SE)	≥3.5 buck $\bar{x}$ (SE)
CA	Pre	1990-1997	5.79(0.38)	3.94(0.27)	68.1	1.85(0.17)	31.9	9.8	0.95(0.10)	0.19(0.03)
CA	Post	1999-2006	4.18(0.33)	2.78(0.21)	66.9	1.40(0.16)	33.1	15.7	1.98(0.16)	0.44(0.04)
				P<0.01		*P*=0.08	*P*=0.67	*P*=0.19	*P*<0.01	*P*<0.01
OR	Pre	1998-2000	11.95(0.48)	7.03(0.62)	58.7	4.91(0.25)	41.3	19.0	2.35(0.48)	0.54(0.14)
OR	Post	2004-2006	11.01(1.35)	4.79(0.52)	43.6	6.23(0.84)	56.4	13.5	3.51(0.41)	0.91(0.13)
				P=0.05		*P*=0.21	*P*=0.01	*P*=0.12	*P*=0.14	*P*=0.12
YU	Pre	2001-2002	43.98(1.13)	20.92(1.37)	47.7	23.06(2.49)	52.3	11.8	3.54(1.32)	0.68(0.46)
YU	Post	2004-2006	28.52(1.23)	10.81(1.69)	37.6	17.70(0.66)	62.4	19.3	4.22(0.56)	0.67(0.46)
				P=0.02		*P*=0.07	*P*=0.22	*P*=0.06	*P*=0.53	*P*=0.98

[a]Catoosa (CA) WMA standardized based on hunter estimates, while Oak Ridge (OR) and Yuchi (YU) WMA standardized based on quota permits issued. Data expressed as deer harvested per 100 hunters (CA) or quota permits (OR and YU) issued.
[b]Significance values of tests for before and after comparisons within a site are indicated under columns of variables tested. All variables were not tested to lower Type I error and because of the relatedness of some variables.
[c]Antler restrictions and year of implementation were: CA-four one-inch antler points on one side of the rack minimum in 1998; OR and YU- four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum in 2003.

Table 3 cont. Average harvest characteristics on (SE) on Wildlife Management Areas in Tennessee before and after QDM.

Site[a]	Period	Years[b]	Acres per buck $\bar{x}$ (SE)	Acres per doe $\bar{x}$ (SE)	Acres per ≥2.5 buck $\bar{x}$ (SE)	Acres per ≥3.5 buck $\bar{x}$ (SE)
CA	Pre	1990-1997	230(26)	502(60)	981(104)	5650(1208)
CA	Post	1999-2006	418(51)	910(173)	583(57)	2582(171)
OR	Pre	1998-2000	181(10)	259(22)	570(81)	2705(704)
OR	Post	2004-2006	264(14)	205(15)	360(14)	1412(137)
YU	Pre	2001-2002	29(2)	27(6)	188(49)	1478(887)
YU	Post	2004-2006	51(8)	30(1)	128(15)	NA[c]

[a]CA=Catoosa WMA, OR=Oak Ridge WMA, YU=Yuchi WMA

[b]Antler restrictions and year of implementation were: CA-four one-inch antler points on one side of the rack minimum in 1998; OR and YU- four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum in 2003.

[c]No bucks ≥3.5 years of age were killed at Yuchi WMA in 2005 preventing calculation of a post-QDM mean for this variable.

Table 4. Number and percentage of bucks killed in each age class by year on Ames Plantation, Fayette and Hardeman Counties, Tennessee, 2002-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2002	25	15.0	85	50.9	39	23.4	11	6.6	0	0.0	0	0.0	7	4.2
2003	13	16.9	40	51.9	20	26.0	2	2.6	1	1.3	0	0.0	1	1.3
2004[a]	29	59.2	1	2.0	10	20.4	8	16.3	1	2.0	0	0.0	0	0.0
2005	29	33.0	6	6.8	27	30.7	22	25.0	3	3.4	0	0.0	1	1.1
2006	23	37.7	2	3.3	12	19.7	17	27.9	7	11.5	0	0.0	0	0.0

[a]Antler restrictions (110-inch gross score minimum or 5.5 years old) implemented in 2004 and changed to 120-inch (or 4.5 years old) in 2006.

Table 5. Number and percentage of does killed in each age class by year on Ames Plantation, Fayette and Hardeman Counties, Tennessee, 2002-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2002	15	15.6	19	19.8	30	31.3	16	16.7	6	6.3	6	6.3	4	4.2
2003	16	22.5	14	19.7	27	38.0	7	9.9	2	2.8	5	7.0	0	0.0
2004[a]	41	21.1	56	28.9	53	27.3	25	12.9	6	3.1	13	6.7	0	0.0
2005	38	16.7	58	25.4	73	32.0	35	15.4	14	6.1	9	3.9	1	0.4
2006	26	13.7	47	24.7	45	23.7	36	18.9	19	10.0	17	8.9	0	0.0

[a]Antler restrictions (110-inch gross score minimum or 5.5 years old) implemented in 2004 and changed to 120-inch (or 4.5 years old) in 2006.

Table 6. Annual harvest characteristics[a] on Ames Plantation, Fayette and Hardeman Counties, Tennessee, 2002-2006.

Year	Total	Bucks	% of total	Does	% of total	Buck fawns in antlerless harvest %	≥2.5 buck	≥3.5 buck
2002	0.83	0.53	63.5	0.30	36.5	20.7	0.16	0.03
2003	2.87	1.48	52.0	1.37	48.0	15.5	0.44	0.06
2004[b]	3.64	0.73	20.2	2.90	79.8	13.0	0.28	0.13
2005	3.17	0.88	27.8	2.28	72.2	11.3	0.52	0.25
2006	2.01	0.49	24.3	1.52	75.7	10.8	0.29	0.19

[a]**Count variables were standardized on a per hunter basis** to account for differences in hunter numbers across years: 316 in 2002, 52 in 2003, 67 in 2004, 100 in 2005, 125 in 2006.

[b]Antler restrictions (110-inch gross score minimum or 5.5 years old) implemented in 2004 and changed to 120-inch (or 4.5 years old) in 2006.

Table 7. Number and percentage of bucks killed in each age class by year on Rocky River Hunting Club, Sequatchie, Van Buren, and Warren Counties, Tennessee, 2000-2003.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2000[a]	2	15.4	0	0.0	7	53.8	3	23.1	1	7.7	0	0.0	0	0.0
2001	5	33.3	1	6.7	6	40.0	2	13.3	0	0.0	1	6.7	0	0.0
2002	6	30.0	1	5.0	4	20.0	6	30.0	2	10.0	1	5.0	0	0.0
2003	1	6.7	2	13.3	0	0.0	9	60.0	2	13.3	1	6.7	0	0.0

[a]Antler restrictions (100-inch gross score minimum) implemented in 2000.

Table 8. Number and percentage of does killed in each age class by year on Rocky River Hunting Club, Sequatchie, Van Buren, and Warren Counties, Tennessee, 2000-2003.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2000[a]	2	8.0	5	20.0	8	32.0	4	16.0	4	16.0	2	8.0	0	0.0
2001	3	8.8	13	38.2	8	23.5	7	20.6	1	2.9	2	5.9	0	0.0
2002	8	22.2	9	25.0	6	16.7	3	8.3	6	16.7	4	11.1	0	0.0
2003	7	16.3	10	23.3	9	20.9	4	9.3	5	11.6	8	18.6	0	0.0

[a]Antler restrictions (100-inch gross score minimum) implemented in 2000.

Table 9. Annual harvest characteristics on Rocky River Hunting Club, Sequatchie, Van Buren, and Warren Counties, Tennessee, 2000-2003.

Year	Total *N*	Bucks *N*	% of total	Does *N*	% of total	Buck fawns in antlerless harvest %	Acres per buck	Acres per ≥2.5 buck	Acres per ≥3.5 buck	Acres per doe
2000[a]	38	13	34.2	25	65.8	7.4	369	436	1200	192
2001	49	15	30.6	34	69.4	12.8	320	533	1600	141
2002	56	20	35.7	36	64.3	14.3	240	369	533	133
2003	58	15	25.9	43	74.1	2.3	320	400	400	112

[a]Antler restrictions (100-inch gross score minimum) implemented in 2000.

Table 10. Number and percentage of bucks killed in each age class by year on Jasper Mountain Hunting Club, Marion County, Tennessee, 2001-2003.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2001[a]	2	16.7	0	0.0	6	50.0	4	33.3	0	0.0	0	0.0	0	0.0
2002	1	5.6	0	0.0	5	27.8	10	55.6	2	11.1	0	0.0	0	0.0
2003	1	4.8	0	0.0	9	42.9	9	42.9	2	9.5	0	0.0	0	0.0

[a]Antler restrictions (100-inch gross score minimum) implemented in 2001.

Table 11. Number and percentage of does killed in each age class by year on Jasper Mountain Hunting Club, Marion County, Tennessee, 2001-2003.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2001[a]	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0
2002	1	5.0	7	35.0	1	5.0	6	30.0	2	10.0	3	15.0	0	0.0
2003	2	5.4	8	21.6	11	29.7	6	16.2	4	10.8	6	16.2	0	0.0

[a]Antler restrictions (100-inch gross score minimum) implemented in 2001.

Table 12. Annual harvest characteristics on Jasper Mountain Hunting Club, Marion County, Tennessee, 2001-2003.

Year	Total *N*	Bucks *N*	% of total	Does *N*	% of total	Buck fawns in antlerless harvest %	Acres per buck	Acres per ≥2.5 buck	Acres per ≥3.5 buck	Acres per doe
2001[a]	14	12	85.7	2	14.3	50.0	716	859	2147	4294
2002	38	18	47.4	20	52.6	4.8	477	505	716	429
2003	58	21	36.2	37	63.8	2.6	409	429	781	232

[a]Antler restrictions (100-inch gross score minimum) implemented in 2001.

Table 13. Number and percentage of bucks killed in each age class by year on Catoosa WMA, Cumberland, Morgan, and Fentress Counties, Tennessee, 1985-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
1985	3	0.9	162	46.0	81	23.0	40	11.4	8	2.3	0	0.0	58	16.5
1986	3	0.9	194	55.4	62	17.7	18	5.1	1	0.3	1	0.3	71	20.3
1987	2	0.4	261	56.3	87	18.8	16	3.4	1	0.2	2	0.4	95	20.5
1988	0	0.0	215	51.3	55	13.1	8	1.9	2	0.5	0	0.0	139	33.2
1989	1	0.2	280	53.8	75	14.4	17	3.3	1	0.2	0	0.0	146	28.1
1990	0	0.0	179	48.8	59	16.1	15	4.1	0	0.0	0	0.0	114	31.1
1991	44	8.0	306	55.6	114	20.7	38	6.9	2	0.4	0	0.0	46	8.4
1992	19	3.8	261	52.7	97	19.6	17	3.4	3	0.6	0	0.0	98	19.8
1993	0	0.0	237	63.9	55	14.8	16	4.3	1	0.3	0	0.0	62	16.7
1994	56	17.2	155	47.7	74	22.8	16	4.9	1	0.3	0	0.0	23	7.1
1995	12	3.5	221	64.4	67	19.5	18	5.2	2	0.6	0	0.0	23	6.7
1996	12	3.6	197	59.5	58	17.5	6	1.8	0	0.0	0	0.0	58	17.5
1997	16	7.7	131	63.3	45	21.7	7	3.4	2	1.0	2	1.0	4	1.9
1998[a]	13	22.8	3	5.3	30	52.6	10	17.5	0	0.0	0	0.0	1	1.8
1999	2	1.9	18	16.7	63	58.3	23	21.3	1	0.9	0	0.0	1	0.9
2000	17	10.0	21	12.4	94	55.3	30	17.6	6	3.5	1	0.6	1	0.6
2001	19	8.8	28	12.9	111	51.2	25	11.5	1	0.5	0	0.0	33	15.2
2002	20	9.2	36	16.6	117	53.9	37	17.1	4	1.8	0	0.0	3	1.4
2003	1	0.5	27	13.0	131	63.3	27	13.0	2	1.0	1	0.5	18	8.7
2004	50	26.6	13	6.9	95	50.5	23	12.2	6	3.2	0	0.0	1	0.5
2005	26	10.7	42	17.4	114	47.1	29	12.0	1	0.4	0	0.0	30	12.4
2006	56	18.5	22	7.3	184	60.9	37	12.3	1	0.3	0	0.0	2	0.7

[a]Antler restrictions (four one-inch antler points on one side of the rack minimum) implemented in 1998.

Table 14. Number and percentage of does killed in each age class by year on Catoosa WMA, Cumberland, Morgan, and Fentress Counties, Tennessee, 1985-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
1985	3	11.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	23	88.5
1986	1	2.3	0	0.0	2	4.5	0	0.0	0	0.0	0	0.0	41	93.2
1987	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	50	100.0
1988	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	88	100.0
1989	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	141	100.0
1990	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	154	100.0
1991	37	17.2	39	18.1	71	33.0	19	8.8	13	6.0	15	7.0	21	9.8
1992	29	9.2	52	16.6	62	19.7	37	11.8	4	1.3	13	4.1	117	37.3
1993	0	0.0	23	13.6	17	10.1	5	3.0	1	0.6	0	0.0	123	72.8
1994	57	37.5	23	15.1	25	16.4	8	5.3	4	2.6	3	2.0	32	21.1
1995	12	10.1	23	19.3	28	23.5	14	11.8	3	2.5	8	6.7	31	26.1
1996	13	6.7	44	22.6	28	14.4	12	6.2	8	4.1	17	8.7	73	37.4
1997	15	15.0	23	23.0	21	21.0	11	11.0	4	4.0	9	9.0	17	17.0
1998[a]	12	29.3	10	24.4	10	24.4	4	9.8	1	2.4	2	4.9	2	4.9
1999	6	14.6	8	19.5	14	34.1	7	17.1	2	4.9	4	9.8	0	0.0
2000	15	23.8	20	31.7	16	25.4	2	3.2	3	4.8	3	4.8	4	6.3
2001	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	96	100.0
2002	25	25.5	16	16.3	29	29.6	14	14.3	3	3.1	4	4.1	7	7.1
2003	1	1.1	24	26.1	32	34.8	11	12.0	4	4.3	3	3.3	17	18.5
2004	40	25.0	36	22.5	40	25.0	28	17.5	8	5.0	5	3.1	3	1.9
2005	35	25.7	35	25.7	35	25.7	24	17.6	4	2.9	0	0.0	3	2.2
2006	50	29.9	25	15.0	64	38.3	23	13.8	1	0.6	3	1.8	1	0.6

[a]Antler restrictions (four one-inch antler points on one side of the rack minimum) implemented in 1998.

Table 15. Annual harvest characteristics[a] on Catoosa WMA, Cumberland, Morgan, and Fentress Counties, Tennessee, 1990-2006.

Year	Total	Bucks	% of total	Does	% of total	Buck fawns in antlerless harvest %	≥2.5 buck	≥3.5 buck
1990	5.15	3.62	70.4	1.52	29.6	0.0	0.73	0.15
1991	7.18	5.16	71.9	2.02	28.1	17.0	1.45	0.38
1992	7.22	4.42	61.2	2.80	38.8	5.7	1.04	0.18
1993	5.16	3.54	68.7	1.61	31.3	0.0	0.69	0.16
1994	5.42	3.69	68.1	1.73	31.9	26.9	1.03	0.19
1995	6.16	4.57	74.2	1.59	25.8	9.2	1.16	0.27
1996	5.98	3.76	62.9	2.22	37.1	5.8	0.73	0.07
1997	4.04	2.72	67.4	1.32	32.6	13.8	0.74	0.14
1998[b]	2.91	1.69	58.2	1.22	41.8	24.1	1.19	0.30
1999	3.17	2.30	72.5	0.87	27.5	4.7	1.85	0.51
2000	3.86	2.82	73.0	1.04	27.0	21.3	2.17	0.61
2001	4.48	3.10	69.3	1.37	30.7	16.5	1.96	0.37
2002	3.63	2.50	68.9	1.13	31.1	16.9	1.82	0.47
2003	3.71	2.57	69.2	1.14	30.8	1.1	2.00	0.37
2004	4.06	2.19	54.0	1.87	46.0	23.8	1.45	0.34
2005	4.24	2.71	64.0	1.52	36.0	16.0	1.61	0.34
2006	6.31	4.06	64.4	2.25	35.6	25.1	2.99	0.51

[a]Data expressed as deer harvested **per 100 hunters**.
[b]Antler restrictions (four one-inch antler points on one side of the rack minimum) implemented in 1998.

Table 16. Number and percentage of bucks killed in each age class by year on Oak Ridge WMA, Roane and Anderson Counties, Tennessee, 1985-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
1985	114	22.1	136	26.4	145	28.1	76	14.7	30	5.8	14	2.7	1	0.2
1986	82	21.6	162	42.6	80	21.1	37	9.7	14	3.7	5	1.3	0	0.0
1987	72	22.4	139	43.3	64	19.9	33	10.3	9	2.8	3	0.9	1	0.3
1988	55	18.8	137	46.9	67	22.9	19	6.5	10	3.4	4	1.4	0	0.0
1989	53	20.3	128	49.0	53	20.3	16	6.1	6	2.3	5	1.9	0	0.0
1990	72	30.4	104	43.9	42	17.7	11	4.6	4	1.7	4	1.7	0	0.0
1991	68	25.5	120	44.9	47	17.6	21	7.9	4	1.5	5	1.9	2	0.7
1992	100	35.2	120	42.3	48	16.9	10	3.5	4	1.4	2	0.7	0	0.0
1993	64	30.2	83	39.2	49	23.1	13	6.1	2	0.9	1	0.5	0	0.0
1994	50	16.1	163	52.6	72	23.2	22	7.1	3	1.0	0	0.0	0	0.0
1995	46	15.5	149	50.3	60	20.3	15	5.1	4	1.4	1	0.3	21	7.1
1996	63	26.3	123	51.3	39	16.3	10	4.2	5	2.1	0	0.0	0	0.0
1997	49	18.3	151	56.3	57	21.3	8	3.0	2	0.7	0	0.0	1	0.4
1998	29	15.6	98	52.7	40	21.5	16	8.6	3	1.6	0	0.0	0	0.0
1999	34	15.0	100	44.2	72	31.9	16	7.1	2	0.9	0	0.0	2	0.9
2000	38	18.5	112	54.6	46	22.4	9	4.4	0	0.0	0	0.0	0	0.0
2002	31	10.5	133	44.9	106	35.8	21	7.1	5	1.7	0	0.0	0	0.0
2003[a]	31	34.8	11	12.4	26	29.2	19	21.3	2	2.2	0	0.0	0	0.0
2004	21	14.5	13	9.0	81	55.9	25	17.2	5	3.4	0	0.0	0	0.0
2005	41	27.3	7	4.7	79	52.7	21	14.0	1	0.7	0	0.0	1	0.7
2006	24	18.9	6	4.7	69	54.3	22	17.3	5	3.9	1	0.8	0	0.0

[a]Antler restrictions (four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum) implemented in 2003. No hunts held in 2001 because of national security concerns.

Table 17. Number and percentage of does killed in each age class by year on Oak Ridge WMA, Roane and Anderson Counties, Tennessee, 1985-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
1985	112	27.3	71	17.3	114	27.7	67	16.3	30	7.3	17	4.1	0	0.0
1986	82	29.3	54	19.3	87	31.1	32	11.4	15	5.4	10	3.6	0	0.0
1987	67	32.2	54	26.0	46	22.1	28	13.5	4	1.9	9	4.3	0	0.0
1988	58	27.0	58	27.0	67	31.2	22	10.2	6	2.8	4	1.9	0	0.0
1989	47	26.3	38	21.2	63	35.2	12	6.7	8	4.5	11	6.1	0	0.0
1990	53	26.0	66	32.4	59	28.9	18	8.8	4	2.0	4	2.0	0	0.0
1991	71	34.0	59	28.2	47	22.5	21	10.0	8	3.8	3	1.4	0	0.0
1992	71	30.1	55	23.3	71	30.1	21	8.9	5	2.1	13	5.5	0	0.0
1993	50	26.6	51	27.1	68	36.2	9	4.8	4	2.1	6	3.2	0	0.0
1994	43	23.4	48	26.1	66	35.9	16	8.7	8	4.3	3	1.6	0	0.0
1995	32	29.9	37	34.6	28	26.2	4	3.7	2	1.9	4	3.7	0	0.0
1996	76	34.1	63	28.3	69	30.9	4	1.8	5	2.2	6	2.7	0	0.0
1997	43	25.3	56	32.9	52	30.6	13	7.6	2	1.2	4	2.4	0	0.0
1998	42	28.6	31	21.1	52	35.4	14	9.5	1	0.7	7	4.8	0	0.0
1999	24	19.5	33	26.8	49	39.8	8	6.5	5	4.1	4	3.3	0	0.0
2000	35	21.2	44	26.7	59	35.8	16	9.7	3	1.8	7	4.2	1	0.6
2002	21	16.8	38	30.4	45	36.0	13	10.4	5	4.0	1	0.8	2	1.6
2003[a]	26	15.6	54	32.3	58	34.7	18	10.8	4	2.4	7	4.2	0	0.0
2004	32	16.2	47	23.9	62	31.5	43	21.8	7	3.6	6	3.0	0	0.0
2005	39	20.2	37	19.2	88	45.6	19	9.8	3	1.6	5	2.6	2	1.0
2006	29	18.5	48	30.6	48	30.6	20	12.7	4	2.5	8	5.1	0	0.0

[a]Antler restrictions (four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum) implemented in 2003. No hunts held in 2001 because of national security concerns.

Table 18. Annual harvest characteristics[a] on Oak Ridge WMA, Roane and Anderson Counties, Tennessee, 1998-2006.

Year	Total	Bucks	% of total	Does	% of total	Buck fawns in antlerless harvest %	≥2.5 buck	≥3.5 buck
1998	12.11	6.76	55.9	5.35	44.1	16.5	2.15	0.69
1999	12.69	8.22	64.8	4.47	35.2	21.7	3.27	0.65
2000	11.04	6.12	55.4	4.93	44.6	18.7	1.64	0.27
2002	15.31	10.76	70.3	4.55	29.7	19.9	4.80	0.95
2003[b]	8.53	2.97	34.8	5.57	65.2	15.7	1.57	0.70
2004	13.28	5.63	42.4	7.65	57.6	9.6	4.31	1.17
2005	11.15	4.88	43.7	6.28	56.3	17.5	3.28	0.72
2006	8.61	3.85	44.7	4.76	55.3	13.3	2.94	0.85

[a]Data expressed as deer harvested **per 100 permits**.

[b]Antler restrictions (four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum) implemented in 2003. No hunts held in 2001 because of national security concerns.

Table 19. Number and percentage of bucks killed in each age class by year on Yuchi WMA, Rhea County, Tennessee, 2001-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2001	8	10.3	41	52.6	13	16.7	4	5.1	0	0.0	0	0.0	12	15.4
2002	18	20.5	43	48.9	9	10.2	1	1.1	0	0.0	0	0.0	17	19.3
2003[a]	11	45.8	2	8.3	5	20.8	2	8.3	0	0.0	0	0.0	4	16.7
2004	21	45.7	1	2.2	17	37.0	7	15.2	0	0.0	0	0.0	0	0.0
2005	20	31.7	4	6.3	16	25.4	0	0.0	0	0.0	0	0.0	23	36.5
2006	16	43.2	2	5.4	15	40.5	2	5.4	0	0.0	0	0.0	2	5.4

[a]Antler restrictions (four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum) implemented in 2003.

Table 20. Number and percentage of does killed in each age class by year on Yuchi WMA, Rhea County, Tennessee, 2001-2006.

	Age class													
	0.5		1.5		2.5		3.5		4.5		≥5.5		no age	
Year	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2001	15	20.8	11	15.3	18	25.0	7	9.7	9	12.5	2	2.8	10	13.9
2002	17	14.8	30	26.1	22	19.1	18	15.7	8	7.0	2	1.7	18	15.7
2003[a]	13	18.3	29	40.8	8	11.3	8	11.3	3	4.2	5	7.0	5	7.0
2004	25	29.8	20	23.8	15	17.9	15	17.9	5	6.0	3	3.6	1	1.2
2005	18	24.3	23	31.1	4	5.4	8	10.8	12	16.2	7	9.5	2	2.7
2006	23	28.4	21	25.9	7	8.6	16	19.8	9	11.1	5	6.2	0	0.0

[a]Antler restrictions (four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum) implemented in 2003.

Table 21. Annual harvest characteristics[a] on Yuchi WMA, Rhea County, Tennessee, 2001-2006.

Year	Total	Bucks	% of total	Does	% of total	Buck fawns in antlerless harvest %	≥2.5 buck	≥3.5 buck
2001	42.86	22.29	52.0	20.57	48.0	10.0	4.86	1.14
2002	45.11	19.56	43.3	25.56	56.7	13.5	2.22	0.22
2003[b]	21.11	5.33	25.3	15.78	74.7	13.4	1.56	0.44
2004	28.89	10.22	35.4	18.67	64.6	20.0	5.33	1.56
2005	30.44	14.00	46.0	16.44	54.0	21.3	3.56	0.00
2006	26.22	8.22	31.4	18.00	68.6	16.5	3.78	0.44

[a]Data expressed as deer harvested **per 100 permits**.
[b]Antler restrictions (four one-inch antler points on one side of the rack or an outside antler spread of 15 inches minimum) implemented in 2003.

II. AN EVALUATION OF COOL- AND WARM-SEASON FORAGES FOR WHITE-TAILED DEER FOOD PLOTS

Abstract

Production and nutritional quality of twenty forages were measured to determine species appropriate for use in habitat management programs. Crimson clover typically led production in winter months and produced large amounts (generally more than 1,000 lbs/acre) of forage prior to spring green-up. Forage production by arrowleaf clover was relatively low during winter but increased to more than 2,000 lbs/acre in April and May. Ladino white clover provided high-quality and quantity forage (generally more than 1,000 lbs/acre in excess of 20% CP) from April through June. Chicory production was more than 1,000 lbs/acre from April through June in the first year of the study, but production was reduced in the second year because of overgrazing and weed competition. As production of cool-season perennials declined in summer, warm-season annual production averaged more than 1,000 lbs/acre. Crimson clover and a cool-season grain, such as wheat or oats, are recommended to address the mid-late winter stress period, and arrowleaf clover may be added to further extend forage availability in the spring. Ladino white clover and chicory are recommended to supplement nutritional gaps of annual forages, while cowpeas, lablab, and soybeans are recommended to supply forage during the late summer stress period when natural forage quality is low.

Introduction

As white-tailed deer (*Odocoileus virginianus*) populations have grown throughout the South, wildlife managers and landowners are increasingly interested in habitat management practices that may benefit this important game species. An active habitat management program that provides optimum nutrition to the deer herd throughout the

year is an integral part of a quality deer management (QDM) program. In the South, late winter and late summer are nutritionally limiting seasons because of reductions in forage quality and quantity (Miller 2001). Practices to improve habitat typically involve forest management, old-field habitat manipulation, and food plot establishment.

Planting food plots is the single-most popular white-tailed deer habitat management practice among landowners. Food plots get more publicity in the popular press than all other land management practices combined. Marketing and advertising campaigns of companies selling food plot seed have stimulated extreme interest among landowners and hunters, and there is considerable demand for accurate information about growing and managing successful food plots for most wildlife, especially white-tailed deer. Research has shown differences in production, nutritional quality, deer preference, and cost of various forage species (Waer et al. 1992, 1994, 1997). While cost of food plots may be prohibitive in some cases (McBryde 1995), planting as little as 1% of an area in food plots can show benefits to the deer herd (Miller 2001).

To determine appropriate forage plantings for white-tailed deer in Tennessee, a total of 20 cool- and warm-season forages were evaluated in this study. Cool-season annual species were arrowleaf clover (*Trifolium vesiculosum*), berseem clover (*Trifolium alexandrinum*), crimson clover (*Trifolium incarnatum*), Austrian winter pea (*Pisum sativum*), wheat (*Triticum aestivum*), oats (*Avena sativa*), annual ryegrass (*Lolium multiflorum*), and dwarf essex rape (*Brassica napus*). Cool-season perennial species were alfalfa (*Medicago sativa*), birdsfoot trefoil (*Lotus corniculatus*), red clover (*Trifolium pratense*), ladino white clover (*Trifolium repens*), orchardgrass (*Dactylis glomerata*), and chicory (*Cichorium intybus*). Warm-season annual species were bush-type soybeans

(*Glycine max*), cowpeas (*Vigna unguiculata*), alyceclover (*Alysicarpus vaginalis*), American jointvetch (*Aeschynomene americana*), lablab (*Lablab purpureus*), and vining soybeans (*Glycine max*). Some of these species have been tested in other areas of the South (McDonald and Miller 1995, Waer et al. 1992, 1994, 1997); however, data from a simultaneous comparison of these forages has not been conducted. Specific objectives of this study were to:

1) determine production of various forage species with continuous deer grazing;

2) determine nutritional quality of various forage species.

Study Areas

Originally, four areas were going to be used for this study. Ames Plantation is located in the Coastal Plain physiographic province, while Yuchi WMA is located in the Ridge and Valley physiographic province. The other two areas (Catoosa WMA and Rocky River Hunting Club) are located in the Cumberland Plateau physiographic province.

Ames Plantation

Research plots at Ames Plantation were located on a Grenada silt loam, which are formed in thick loess and characterized as moderately well drained, silty soils on uplands (Flowers 1964). Plots were located on eroded areas with 2-5% slopes. They are acidic and have a fragipan that may cause them to be slightly wet during the winter and spring and dry in the summer (Flowers 1964).

Yuchi WMA

Within the Ridge and Valley physiographic province of Tennessee, research plots were established at Yuchi Refuge at Smith Bend in Rhea County, Tennessee. Plots at this site were established on a Conasauga silt loam, which has adequate surface drainage but slow internal drainage (Hasty 1948). Bedrock is at a depth of 20-36 inches, and natural productivity is only fair (Hasty 1948).

Catoosa WMA and Rocky River.

Two other sites (Catoosa WMA and Rocky River Hunting Club) were going to be used in this study, producing a total of four replications. However, problems unique to each site resulted in loss of data. Feral hogs (*Sus scrofa*) began using the research plot at Catoosa WMA, while wet site conditions at Rocky River resulted in poor establishment and subsequent growth of forages. Therefore, only data from the remaining sites are analyzed and included here.

Materials and Methods

A 2-acre field was located on each study area, and 20 0.1-acre cells were established within each field. Fields were limed and fertilized (P and K) according to soil test results prior to each planting. Legumes were inoculated with the appropriate bacteria species prior to planting. After incorporating lime and fertilizer with a disk, forages were planted using a hand seeder. Cells were then disked or cultipacked depending upon the seed size of each forage species. Appropriate herbicides (imazethapyr, clethodim, 2,4-D, and/or glyphosate) were used to minimize weed pressure.

Each of the 20 cells (experimental unit) was randomly assigned a single species of forage, which was planted in the cell throughout the study. Cool-season annual and perennial plots were established in fall 2004 (Ames Plantation – September 1, 2004, Yuchi WMA – September 13, 2004), and cool-season annual plots were replanted in fall 2005 (Ames Plantation – October 4, 2005, Yuchi WMA – October 11, 2005). Cool-season annual forage species planted and their associated seeding rates were: 'Yuchi' arrowleaf clover (10 lbs/ac), 'Bigbee' berseem clover (20 lbs/ac), 'Dixie' crimson clover (25 lbs/ac), Austrian winter pea (50 lbs/ac), wheat (100 lbs/ac), oats (100 lbs/ac), 'Marshall' annual ryegrass (30 lbs/ac), and dwarf essex rape (8 lbs/ac). Cool-season perennials and their seeding rates were: 'Buffalo' alfalfa (20 lbs/ac), 'Norcen' birdsfoot trefoil (10 lbs/ac), 'Red-Gold Plus' red clover (15 lbs/ac), 'Advantage' ladino white clover (8 lbs/ac), 'Potomac' orchardgrass (20 lbs/ac), and 'Puna' chicory (10 lbs/acre).The grasses, dwarf essex rape, and chicory plots were fertilized with ammonium nitrate (34-0-0) at a rate of 30 lb N/acre during spring 2005 and 2006. Because of overgrazing, the red clover and alfalfa plots at Yuchi WMA were replanted when the cool-season annual plots were planted in fall 2005. Warm-season annual plots were planted during summer 2005 (Ames Plantation – May 24, 2005, Yuchi WMA – May 31, 2005) and 2006 (Ames Plantation – May 18, 2006, Yuchi WMA – May 19, 2006) Warm-season annuals and their seeding rates were: bush-type soybeans (85 lbs/ac), 'Iron-and-Clay' cowpeas (75 lbs/ac), alyceclover (20 lbs/ac), American jointvetch (15 lbs/ac), 'Rongai' lablab (20 lbs/ac), and 'Quail Haven' soybeans (40 lbs/ac). A Group IV soybean variety ('MPRIDE 4905 RR') was planted in summer 2005, while a Group V variety ('Progeny 5250 RR') was used in summer 2006 for the bush-type soybean plots.

Estimates of deer using each field were obtained August/September 2004 and 2005 by placing 4 cameras around each field. Shelled corn was spread in front of the cameras, and an estimate of deer numbers was obtained in a similar manner as an infrared-camera census (Jacobson et al. 1997).

To compare the production and nutritional quality of these forages, three exclosure cages (slightly larger than 4 ft^2)were placed within the cell of each planting. Throughout the duration of the study, 4-ft^2 samples were clipped from inside each exclosure and three 4-ft^2 samples were clipped outside of the exclosures. Clipped areas were flagged to minimize resampling during subsequent periods, and cages were moved to other areas for the next sampling period. Plots were clipped approximately one to two inches aboveground. Samples were dried in a forced-air oven at 50^oC and weighed to the nearest gram to determine dry-matter weights.

To calculate production of each forage species, the average weight of the three uncaged samples from the previous sampling period were subtracted from the average weight of the three caged samples from the current period. Nutritional quality of forages was assessed for several periods at each site. Tests for quality (crude protein, neutral detergent fiber, acid detergent fiber) were obtained by combining all three caged samples within a given sampling period, grinding with a Wiley mill until particles passed through a 1-mm screen, and then sending to Sure-Tech Laboratories in Indianapolis, Indiana for analysis.

Although no statistical differences in percent use comparisons among forages were detected, visual observations of plots indicated differential use by deer. Failure to detect differences can be attributed to loss of plots (replications) at two sites, as well as

large differences in percent use of forages between the two remaining replicates. Deer density estimates at Yuchi WMA were almost double those at Ames Plantation, resulting in very disparate percent use means (0% use vs. 100% use in some cases) and high variation. Other researchers have noted problems in separating utilization rates of forages because of high variability, even when visual observations indicate "obvious" differences in use (McDonald and Miller 1995). Future studies should increase replications within a site (i.e., multiple fields) to increase the ability to detect differences. Other confounding factors that must be addressed include field size, deer density, amount of forage plots available, and amount of natural forages available.

Statistical Analysis

A CRD with repeated measures was used for the mixed model ANOVA comparing production of forage species within appropriate sampling periods. To compare the percent use of forage species within appropriate sampling periods, a CRD with repeated measures design was used for the mixed model ANOVA. Normality of data was tested using Shapiro-Wilk's statistic, while homogeneity of variances was tested using Levene's test. Unless otherwise noted, both assumptions were met. Negative values in production or percent use were changed to zero to permit statistical analyses. Cool-season perennial and annual forage production and percent use comparisons were made during sampling periods one through five and periods eight through fourteen. Warm-season annual and cool-season perennial forage production and percent use comparisons were made during sampling periods six, seven, fifteen, and sixteen. When significant effects were found, the LSD method ($P<0.050$) was used for mean separation. Although no

statistical analysis of forage nutritional quality was conducted, absolute values are reported by study area for certain sampling periods.

Results

Estimates for deer using the field at Yuchi WMA were 20 and 35 in 2004 and 2005, respectively. Deer using the field at Ames Plantation ranged from 11 in 2004 to 20 in 2005.

There was a forage species x period effect ($F_{156,168}$=2.82, P<0.001) for the cool-season perennial and annual production comparison. A forage species x period effect ($F_{33,36}$=2.32, P=0.008) was also detected for the warm-season annual and cool-season perennial production comparisons. Variances were not equal, but results are reported because the ANOVA was assumed to be robust as a result of the sample size from the number of sampling periods used in the repeated measures ANOVA.

Differences in forage species production occurred across all sampling periods from December 2004 through October 2005, except March 2005 (Table 22). There was no difference in forage production during winter 2005-06 or September 2006, but differences did exist from late March through August, 2006 (Table 23).

Generally, crude protein content of cool-season legumes was higher than values observed for grasses (Tables 24-27). Ladino white and red clover had high crude protein values relative to other cool-season perennials, followed by alfalfa. Warm-season legume crude protein values were generally lower than values for cool-season perennial legumes but still higher than orchardgrass in the same periods. Bush-type soybeans led warm-season annuals in crude protein values.

Discussion

Relatively high production estimates in the first sampling period following establishment of cool-season annual and perennial plots in the first year of the study resulted from the long period between planting and first sampling (September through December 2004). Generally, cool-season annual forages such as crimson and berseem clover led production values in this period (Table 22). Production of annual cool-season forages is typically higher than perennial cool-season forages the winter after planting because seed of most annual species are large and contain more energy than perennial seed. Thus, most annual forages establish relatively quickly and may provide considerable forage during fall/winter after planting. Arrowleaf clover is an obvious exception, with a seed no larger than that of ladino white, and not providing considerable forage until late April/early May. Winter production estimates of wheat and oats in relation to other forages were lower than reported in other studies, but production of these species could be increased with additional nitrogen fertilization. Relatively warm temperatures caused Austrian winter pea and dwarf essex rape plots to mature prior to frost.

No differences were observed in production of cool-season forages in the sampling period following replanting of cool-season annuals in 2005 (Table 23). None of the forages produced over 500 pounds per acre during fall of 2005, largely a result of cold temperatures soon after planting. Planting in 2005 was later than in 2004 because some of the annuals in 2004 matured before onset of cooler temperatures.

Production of forages from December until late February/early March was low for all cool-season forages and no differences occurred during either year of the study.

Several species (alfalfa, arrowleaf clover, chicory, crimson clover, dwarf essex rape, ladino white clover, ryegrass, and wheat) produced at least 100 lbs/acre during period two, but most of the berseem clover died from cold temperatures, resulting in no production during these periods. Relatively little forage was produced by most forages during January and February 2006, but crimson clover approached 1,000 pounds per acre. Although variation precluded any statistical differences, Dixie crimson clover was a consistent producer during both winters of this study, clearly making this an important cool-season forage during the mid-late winter stress period. Arrowleaf clover was the only cool-season annual forage with no production through February 2006. During this time period, crude protein levels were highest in legumes at Ames Plantation (Table 24) and Yuchi WMA (Table 26).

Production of forages differed just prior to browse green-up in the spring. This is a stressful period for white-tailed deer as low mast availability coincides with relatively low forage availability. All cool-season legumes, except berseem clover, Austrian winter peas, and birdsfoot trefoil, produced at least 1,000 pounds of high-quality forage from March to April 2005 (Table 22), and production was led by two cool-season annual (crimson and arrowleaf clover) and perennial (red and ladino white clover) legumes. Only berseem, ladino white, and crimson clover production was close to or over 1,000 pounds during March 2006. Production increases were observed for all cool-season forages by late March 2006, except orchardgrass and oats. Generally, crude protein values were highest for chicory and legumes at both sites during March and April 2005 and 2006 (Tables 24-27). The production and nutritional quality of crimson and ladino

white clover across both years of the study suggest these forages would be useful for addressing the stress period prior to browse green-up.

Forage production from food plots from April through June (sampling periods four, five, twelve, thirteen, and fourteen) is probably least important for white-tailed deer in habitats where deer are not overpopulated and natural foods are available (Miller 2006). However, where high-quality natural forages are lacking, this is a critical period for white-tailed deer as bucks are beginning antler growth and does are building nutrient and fat reserves for lactation (Verme and Ullrey 1984). Except for arrowleaf clover, all annual cool-season forages peaked in production during May as plants reached reproductive stages. The later production of arrowleaf clover (peaking in June) extends forage availability when included in a mixture with crimson clover. Based upon their high production and high levels of crude protein from April through June, ladino white and red clover and alfalfa were the most important forages during this time.

Kammermeyer et al. (1993) also noted high production of ladino white clover during May, August, and September with crude protein levels averaging 24% across all months. Waer et al. (1994) reported highest use of ladino white clover from April through June. Along with birdsfoot trefoil, ladino white clover was more digestible (low ADF values) when compared to other forages. Least important from April through June were non-legume species (ryegrass, orchardgrass, rape) which had lower crude protein levels and lower digestibility (high ADF values). Although natural forages may comprise a higher percentage of diets than planted forages from April through June, providing forages such as ladino white clover may increase crude protein levels of the diet and help provide adequate nutrition to bucks starting antler development and gestating does.

During the summer, warm-season annuals and cool-season perennials can provide nutrition to lactating does and bucks continuing antler development. In the late summer, planted forages can address a stress period when natural forage quality is low. This is also when fawns begin grazing prior to mast becoming available. Warm-season legumes produced abundant forage during August 2005 (Table 22). Lablab, iron-and-clay cowpeas, bush-type soybeans, and Quail Haven soybeans produced the most forage through early August 2006 (Table 23). However, two warm-season annuals (lablab and bush-type soybeans) did not produce forage through September 2005, likely a result of poor recovery from grazing pressure and weed contamination of plots. Although herbicides (imazethapyr) were used in lablab plots, there is no herbicide that will control sicklepod in lablab plots. Bush-type soybeans were Roundup Ready, which allowed for adequate weed control, but were grazed so heavily little production occurred after the first sampling. From August to September 2006, alyceclover and American jointvetch were the only forages to produce more than 1,000 pounds per acre. Although ladino white clover, red clover, and alfalfa maintained high levels of crude protein in the summer months, production of these and other cool-season perennial forages were lower than warm-season annual forages. By selecting appropriate warm-season annual forage species, managers can address the late summer nutritional stress period and supplement production gaps of cool-season perennial forages.

Management Recommendations

When determining appropriate forage species for plantings, managers must have defined goals. If food plots are established to enhance hunting opportunities, cool-season

annual and perennial forages are typically appropriate, but plantings of warm-season forages can attract deer until frost. When trying to provide optimum nutrition to the deer herd throughout the year, warm-season forages should also be considered if nutrition is limiting through late summer. No single species can provide large quantities of nutritious forage throughout the year (Waer et al. 1992, McDonald and Miller 1995).

Within the broad groups of cool- and warm-season forages, selection of forage species is dependent upon several factors, such as forage production and resistance to grazing, white-tailed deer use and herd densities, nutritional quality, conditions of the site to be planted, and agronomic characteristics of forage species. Production values in this study represent the average production of forages under different deer density conditions and are a reflection of forage use and the ability of forages to resist grazing pressure. Two species (alfalfa and red clover) had to be replanted because of overgrazing at the high deer density site (Yuchi WMA); however, different varieties of these forages may have a higher tolerance to grazing pressure.

Although no statistical differences were observed in percent use of forages, visual observations during plot sampling indicated biological differences in deer use of the forages. All forages tested in this study received use at some point on Yuchi WMA, attributed to the high deer density at this site. However, differential use of forages was still observed at Yuchi WMA and Ames Plantation, an area where use may more accurately reflect selection of forages. Orchardgrass received use in the first few months after establishment at Yuchi WMA, but no visual indication of use occurred thereafter. No visual differences in cages and the rest of the cell were observed for orchardgrass at any sampling period at Ames Plantation. Conversely, bush-type soybeans were used

heavily at both sites. This suggests that while deer may use any of the forages in some conditions, some species will not always receive use and benefit the deer herd.

Results from the qualitative analysis of nutritional quality of forages indicated legumes were higher in crude protein than the grasses. Lower crude protein values in warm-season annual forages than typically observed in other studies is a reflection of sampling methodology. In this study, all plant parts were ground for analysis resulting in lowered estimates of crude protein than analyzing only leaves and new growth. Finally, poor establishment and growth of forages at one of the sites excluded from analysis emphasizes the importance of site selection and consideration of species characteristics.

Based upon production, grazing tolerance, nutritional quality, and visual observations of deer use, several cool-season annual forages are recommended for food plots in Tennessee. Crimson clover produced large amounts of forage during the late winter stress period for white-tailed deer. Additionally, this forage was high in nutritional quality and tolerated heavy deer use. The cool-season grains (oats and wheat) tested in this study also provided forage during winter. Wheat may be preferable because of the potential for winterkill in oats. Increased production of wheat and oats may be realized with increased nitrogen fertilization. Rising nitrogen fertilizer costs make the addition of crimson and arrowleaf clovers to wheat and oats an economical decision that will yield more nutrients per acre.

Several characteristics of the other cool-season annual forages make them less useful for forage plantings in Tennessee. While production of berseem clover was high during the second year of the study, low production in the first year suggests its use in Tennessee may be limited because of winterkill (Ball et al. 2002). Arrowleaf clover

production was low during the late winter stress period, but it may be useful to complement crimson clover because crimson clover produces forage relatively quickly after planting and dies in May. Austrian winter peas received little use at the low deer density site, and produced little forage at the high deer density site following intense grazing. No visual use was observed for dwarf essex rape and annual ryegrass at the low deer density site. Annual ryegrass can be an aggressive pest and cause problems in future forage plantings (Kammermeyer 2006). In fact, annual ryegrass contamination of wheat and oat plots likely lowered production of these species during the second year of the study; therefore, annual ryegrass is not recommended for use in food plots.

Warm-season annual forages can be used to target the late summer stress period and supplement diets of lactating does, bucks undergoing antler development, and growing fawns. Most warm-season forages were readily used by deer throughout the summer at both sites, however there were two exceptions. Alyceclover received little use at the low deer density site and is not recommended for use in food plots. Deer tended to use iron-and-clay cowpea plots later in the growing season. While bush-type soybeans were used heavily at both deer densities, recovery after grazing was low. When noxious weeds (i.e., sicklepod) are in the seedbank, Roundup Ready soybeans can provide forage while limiting weed competition. However, bush-type soybeans are sensitive to grazing pressure. Thus, deer density and field size/layout are important considerations. Results from this study and others (McDonald and Miller 1995) suggest American jointvetch is a desirable forage for addressing the late summer stress period while also tolerating grazing pressure. However, seed contamination of commercial seed sources may limit availability of American jointvetch (Kammermeyer 2006). Lablab, iron-and-clay cowpeas, and Quail

Haven soybeans are suitable for Tennessee. Beals et al. (1993) suggested lablab may be a more suitable warm-season annual forage than soybeans or cowpeas because of productivity and drought tolerance. Feather and Fulbright (1995) found lablab and cowpeas were similar in palatability, but suggested lablab was a desirable alternative in Texas because of drought and grazing tolerance.

Cool-season perennial forages can fill nutritional gaps left by warm and cool-season annuals and complement forage production at other times of the year. Based on results from this study and others, ladino white clover is likely the best choice for a cool-season perennial planting in Tennessee. Ladino white clover led production values in several periods and provided forage during stress periods, while maintaining high crude protein levels throughout. Additionally, ladino white clover withstood heavy grazing pressure at the high deer density site while alfalfa and red clover plots were overgrazed. Visual observations of chicory plots indicated high use, but production was typically lower than other cool-season perennials. Chicory and red clover could be used in mixtures with ladino clovers if desirable. Birdsfoot trefoil production was low relative to other cool-season perennials, and visual observations indicated use was lower than other cool-season perennial legumes. Orchardgrass led production during some periods, but it is not recommended for food plots because of low deer use and relative poor nutritional quality.

Several forages tested in this study were identified that can provide improved nutrition and forage availability to white-tailed deer across seasons in Tennessee. Crimson clover is the recommended cool-season annual forage and can be included in mixes with cool-season grains to enhance hunting opportunities and address the late

winter nutritional stress period. Ladino white clover is the most desirable cool-season perennial, but separation of warm-season annuals is not as defined. Alyceclover is not recommended, while recommendations for other warm-season annuals tested are dependent on several factors. Along with proper management of the herd and existing habitat, selecting appropriate forages for use in food plots can provide enhanced hunting and management opportunities.

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Appendix

Table 22. Average production (DM lbs/acre) following the previous clipping of forage species by sampling period[a] across two sites (Ames Plantation in Fayette County and Yuchi WMA in Rhea County) in Tennessee from December 2004-October 2005.

Forage species	Dec 2004		Mar 2005		April 2005		May/June 2005		June/July 2005		Aug 2005		Oct 2005	
	$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$	
alfalfa	1392	DEF	328	A	1352	ABC	2860	BC	1104	AB	740	EF	0	B
alyceclover	-	-	-	-	-	-	-	-	-	-	2917	BCDE	1532	AB
arrowleaf clover	1136	EF	252	A	2200	AB	3201	BC	48	B	-	-	-	-
Austrian winter peas	1768	CDE	84	A	40	D	8	F	0	B	-	-	-	-
berseem clover	3053	AB	0	A	48	D	816	EF	0	B	-	-	-	-
birdsfoot trefoil	704	EF	0	A	344	CD	1220	DE	644	AB	288	F	0	B
chicory	1400	DEF	124	A	396	CD	3577	AB	1120	AB	1124	CDEF	0	B
cowpeas	-	-	-	-	-	-	-	-	-	-	4277	B	716	B
crimson clover	4041	A	212	A	2424	A	2244	CD	0	B	-	-	-	-
dwarf essex rape	1504	CDE	208	A	452	CD	1576	DE	0	B	-	-	-	-
American jointvetch	-	-	-	-	-	-	-	-	-	-	3257	BC	3453	A
lablab	-	-	-	-	-	-	-	-	-	-	2688	BCDE	0	B
ladino white clover	1552	CDE	188	A	1636	AB	3109	BC	700	AB	1280	CDEF	344	B
oats	2504	BCD	4	A	268	CD	508	EF	0	B	-	-	-	-
orchardgrass	328	F	92	A	1048	BCD	1336	DE	1248	A	952	DEF	1852	AB
vining soybeans	-	-	-	-	-	-	-	-	-	-	3105	BCD	1752	AB
red clover	1056	EF	52	A	1912	AB	3945	AB	632	AB	304	F	264	B
ryegrass	2612	BC	276	A	1428	ABC	4573	A	0	B	-	-	-	-
bush-type soybeans	-	-	-	-	-	-	-	-	-	-	6978	A	0	B
wheat	704	EF	228	A	376	CD	1596	DE	0	B	-	-	-	-

[a]Within a period, means are different ($P<0.05$) if not followed by the same letter. Hyphens indicate forages were not included in the ANOVA comparison during a sampling period. December 2004 represents production from September 2004.

Table 23. Average production (DM lbs/acre) following the previous clipping of forage species by sampling period[a] across two sites (Ames Plantation in Fayette County and Yuchi WMA in Rhea County) in Tennessee from November 2005-September 2006.

Forage species	Dec 2005		Jan 2006		Feb 2006		Mar 2006		May 2006		June 2006		July 2006		Aug 2006		Sept 2006	
	$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$	
alfalfa	0	A	0	A	120	A	700	ABC	1624	CDE	1260	BCDE	80	B	64	B	376	A
alyceclover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	624	B	1088	A
arrowleaf clover	0	A	0	A	0	A	356	ABC	2520	BC	3213	A	316	B	-	-	-	-
Austrian winter peas	360	A	280	A	468	A	512	ABC	1700	CDE	628	CDEF	0	B	-	-	-	-
berseem clover	0	A	492	A	772	A	1228	AB	3913	A	1972	B	0	B	-	-	-	-
birdsfoot trefoil	0	A	0	A	0	A	324	ABC	440	F	984	BCDEF	724	AB	224	B	560	A
chicory	32	A	12	A	4	A	28	C	752	EF	180	EF	240	B	52	B	16	A
cowpeas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3585	A	776	A
crimson clover	3	A	908	A	508	A	956	ABC	3661	AB	0	F	0	B	-	-	-	-
dwarf essex rape	172	A	16	A	40	A	200	ABC	1916	CD	172	EF	0	B	-	-	-	-
American jointvetch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	840	B	1080	A
lablab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3725	A	616	A
ladino white clover	0	A	332	A	0	A	1268	A	2064	CD	1544	BCD	64	B	80	B	412	A
oats	280	A	16	A	104	A	68	BC	1160	DEF	0	F	0	B	-	-	-	-
orchardgrass	208	A	56	A	224	A	0	C	324	F	1164	BCDE	1608	A	1092	B	532	A
vining soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2180	AB	152	A
red clover	288	A	136	A	0	A	584	ABC	2028	CD	1752	BC	112	B	0	B	4	A
ryegrass	144	A	44	A	56	A	64	C	3689	A	588	DEF	0	B	-	-	-	-
bush-type soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3537	A	520	A
wheat	188	A	20	A	48	A	216	ABC	1360	CDEF	0	F	0	B	-	-	-	-

[a]Within a period, means are different (P<0.05) if not followed by the same letter. Hyphens indicate forages were not included in the ANOVA comparison during a sampling period. December 2005 represents production from October 2005 for annuals.

Table 24. Nutritional analyses (%) of forage species by sampling period[a] at Ames Plantation in Fayette County, Tennessee from December 2004-October 2005.

Forage species	12/13/2004			03/05/2005			04/09/2005			05/25/2005			06/17/2005			08/18/2005			10/18/2005		
	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF
Buffalo alfalfa	21	32	25	26	34	31	28	31	29	-	-	-	18	49	43	12	59	48	23	39	32
alyceclover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	42	36	13	55	46
Yuchi arrowleaf clover	15	35	28	29	27	20	29	26	22	-	-	-	13	53	47	-	-	-	-	-	-
Austrian winter peas	25	40	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bigbee berseem clover	20	40	32	-	-	-	27	32	28	-	-	-	-	-	-	-	-	-	-	-	-
Norcen birdsfoot trefoil	16	31	24	21	29	22	23	29	23	-	-	-	17	42	35	11	56	47	16	44	38
Puna chicory	17	31	26	26	17	17	23	18	20	-	-	-	9	45	37	11	46	40	23	48	32
Iron-and-clay cowpeas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	40	34	13	46	42
Dixie crimson clover	19	38	29	27	33	29	25	32	27	-	-	-	-	-	-	-	-	-	-	-	-
dwarf essex rape	13	36	31	13	41	36	11	46	39	-	-	-	-	-	-	-	-	-	-	-	-
American jointvetch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	53	45	10	63	55
lablab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	39	29	16	40	32
Advantage ladino clover	22	34	25	30	25	19	31	21	19	-	-	-	24	30	27	17	43	36	23	31	25
oats	15	56	36	20	43	26	17	36	23	-	-	-	-	-	-	-	-	-	-	-	-
Potomac orchardgrass	16	38	27	19	41	26	18	47	30	-	-	-	8	69	46	8	63	42	7	63	42
Quail Haven soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	41	32	11	57	44
Red-Gold Plus red clover	22	36	23	28	33	28	29	27	27	-	-	-	16	47	42	18	45	39	25	34	32
Marshall ryegrass	12	41	28	10	49	34	15	49	31	-	-	-	-	-	-	-	-	-	-	-	-
bush-type soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	43	36	18	40	31
wheat	18	47	28	14	41	26	18	46	29	-	-	-	-	-	-	-	-	-	-	-	-

[a]Nutritional analyses were not conducted in sampling periods with hyphens. CP=crude protein, NF=neutral detergent fiber, AF=acid detergent fiber

Table 25. Nutritional analyses (%) of forage species by sampling period[a] at Ames Plantation in Fayette County, Tennessee from November 2005-September 2006.

Forage species	12/19/2005			01/21/2006			03/02/2006			03/22/2006			05/04/2006			06/01/2006		
	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF
Buffalo alfalfa	18	50	43	-	-	-	-	-	-	25	38	32	25	37	33	22	39	36
alyceclover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yuchi arrowleaf clover	-	-	-	-	-	-	-	-	-	28	17	18	22	34	28	14	42	38
Austrian winter peas	25	26	19	-	-	-	-	-	-	23	34	27	17	42	34	-	-	-
Bigbee berseem clover	-	-	-	-	-	-	-	-	-	27	30	26	19	43	39	17	46	43
Norcen birdsfoot trefoil	-	-	-	-	-	-	-	-	-	28	28	26	23	34	27	19	38	33
Puna chicory	18	24	21	-	-	-	-	-	-	22	17	18	20	28	29	20	28	27
Iron-and-clay cowpeas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dixie crimson clover	-	-	-	-	-	-	-	-	-	27	29	23	14	49	44	-	-	-
dwarf essex rape	30	21	21	-	-	-	-	-	-	17	26	22	13	45	40	9	55	50
American jointvetch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
lablab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Advantage ladino clover	23	30	26	-	-	-	-	-	-	29	27	20	26	30	25	24	29	28
oats	16	36	22	-	-	-	-	-	-	12	36	20	8	54	36	-	-	-
Potomac orchardgrass	6	58	41	-	-	-	-	-	-	9	60	40	9	62	39	8	61	39
Quail Haven soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red-Gold Plus red clover	20	39	37	-	-	-	-	-	-	29	31	29	21	39	34	14	47	39
Marshall ryegrass	17	45	22	-	-	-	-	-	-	12	32	22	8	57	39	4	66	44
bush-type soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
wheat	16	32	18	-	-	-	-	-	-	13	39	25	8	51	34	-	-	-

[a]Nutritional analyses were not conducted in sampling periods with hyphens. CP=crude protein, NF=neutral detergent fiber, AF=acid detergent fiber

Table 26. Nutritional analyses (%) of forage species by sampling period[a] at Yuchi WMA in Rhea County, Tennessee from December 2004-October 2005.

Forage species	12/17/2004			03/11/2005			04/20/2005			06/11/2005			07/18/2005			08/23/2005			10/12/2005		
	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF
Buffalo alfalfa	19	28	18	28	27	19	27	31	26	19	36	30	-	-	-	17	44	37	-	-	-
alyceclover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	41	35	21	38	31
Yuchi arrowleaf clover	23	29	19	30	14	11	28	25	23	16	44	37	-	-	-	-	-	-	-	-	-
Austrian winter peas	19	23	21	25	28	19	26	26	21	17	44	36	-	-	-	-	-	-	-	-	-
Bigbee berseem clover	21	33	26	28	18	13	26	27	21	17	39	34	-	-	-	-	-	-	-	-	-
Norcen birdsfoot trefoil	15	23	23	-	-	-	16	17	14	18	30	22	-	-	-	18	37	30	17	49	41
Puna chicory	19	22	22	24	23	21	21	24	18	11	45	38	-	-	-	18	37	32	26	26	25
Iron-and-clay cowpeas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	39	35	11	47	40
Dixie crimson clover	17	30	21	28	25	18	19	36	31	-	-	-	-	-	-	-	-	-	-	-	-
dwarf essex rape	15	30	22	14	32	25	14	45	40	10	54	46	-	-	-	-	-	-	-	-	-
American jointvetch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	41	36	20	40	31
lablab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	38	31	11	54	46
Advantage ladino clover	23	29	19	27	19	12	29	22	21	22	33	26	-	-	-	22	32	25	27	30	24
oats	15	41	25	14	33	21	20	32	19	9	60	38	-	-	-	-	-	-	-	-	-
Potomac orchardgrass	12	34	23	20	32	20	20	44	28	10	61	39	-	-	-	10	65	43	9	63	41
Quail Haven soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	46	39	-	-	-
Red-Gold Plus red clover	21	28	19	27	16	12	26	27	27	19	40	33	-	-	-	19	41	37	-	-	-
Marshall ryegrass	10	32	19	10	30	16	16	40	23	4	69	46	-	-	-	-	-	-	-	-	-
bush-type soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	41	33	24	32	22
wheat	12	41	26	12	31	12	24	35	20	9	60	36	-	-	-	-	-	-	-	-	-

[a]Nutritional analyses were not conducted in sampling periods with hyphens. CP=crude protein, NF=neutral detergent fiber, AF=acid detergent fiber

Table 27. Nutritional analyses (%) of forage species by sampling period[a] at Yuchi WMA in Rhea County, Tennessee from November 2005-September 2006.

Forage species	12/12/2005			01/26/2006			02/21/2006			03/30/2006			05/01/2006			06/06/2006		
	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF	CP	NF	AF
Buffalo alfalfa	-	-	-	-	-	-	-	-	-	30	24	18	23	30	24	21	31	26
alyceclover	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yuchi arrowleaf clover	-	-	-	-	-	-	-	-	-	29	14	13	23	27	24	20	33	28
Austrian winter peas	23	22	15	-	-	-	-	-	-	26	26	19	25	30	24	22	36	30
Bigbee berseem clover	-	-	-	-	-	-	-	-	-	28	28	23	20	36	31	18	41	35
Norcen birdsfoot trefoil	-	-	-	-	-	-	-	-	-	22	27	19	24	19	16	19	32	24
Puna chicory	15	23	18	-	-	-	-	-	-	19	15	13	20	23	23	19	25	23
Iron-and-clay cowpeas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dixie crimson clover	-	-	-	-	-	-	-	-	-	28	26	19	14	41	35	-	-	-
dwarf essex rape	23	18	13	-	-	-	-	-	-	23	19	16	14	41	36	10	54	47
American jointvetch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
lablab	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Advantage ladino clover	-	-	-	-	-	-	-	-	-	27	23	17	24	30	23	22	28	20
oats	19	27	14	-	-	-	-	-	-	14	23	13	11	55	34	-	-	-
Potomac orchardgrass	6	58	40	-	-	-	-	-	-	9	58	40	13	57	36	8	66	43
Quail Haven soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Red-Gold Plus red clover	-	-	-	-	-	-	-	-	-	25	13	10	27	24	22	21	34	27
Marshall ryegrass	19	21	12	-	-	-	-	-	-	13	26	14	11	53	35	4	70	46
bush-type soybeans	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
wheat	20	20	12	-	-	-	-	-	-	13	30	15	9	53	34	-	-	-

[a]Nutritional analyses were not conducted in sampling periods with hyphens. CP=crude protein, NF=neutral detergent fiber, AF=acid detergent fiber

III. BROWSE PRODUCTION IN CLOSED-CANOPY HARDWOOD STANDS

Abstract

Browse production and nutritional carrying capacity were evaluated following prescribed burning and understory fertilization in two closed-canopy hardwood stands one growing season after treatment. Nutritional carrying capacity estimates (deer days/acre) for understory fertilization (4.60), prescribed burning (4.55), and prescribed burning with understory fertilization (6.30) were greater than controls (2.80) in a mature mixed hardwood stand on the Cumberland Plateau. In a mature mixed hardwood stand in the Coastal Plain of Tennessee, understory fertilization (8.50) did not affect nutritional carrying capacity, and prescribed burning (2.10) and prescribed burning with understory fertilization (4.20) were lower than controls (6.90). Understory fertilization and prescribed fire in closed-canopy hardwood stands are not recommended for increased deer browse because of variable results among study sites and because the cost per pound of forage produced following fertilization exceeded $26 per pound. Treatments providing increased sunlight through a reduction in percent canopy cover are much more effective and efficient in providing increased browse than using fire or fertilization in a closed-canopy stand.

Introduction

An increasing number of landowners are interested in managing their property for wildlife (Measells et al. 2006), especially white-tailed deer (*Odocoileus virginianus*). Most landowners plant food plots to enhance habitat for white-tailed deer; however, over half (55%) of the land area in Tennessee is considered forest land (Schweitzer 2000). Although most of these landowners realize the importance of forest management for

white-tailed deer and other wildlife, few are willing or interested in harvesting timber, even when there is an ecological and economic incentive. Many landowners also view timber stand improvement practices, such as retention cutting, thinning, and crop tree release as too time consuming and/or obtrusive, thus relatively few implement these practices.

Prescribed fire has been promoted widely from a forest management and wildlife management perspective, and landowners have become more interested and receptive with the idea, especially when they consider the reduced risk of wildfire following prescribed fire. Most work relating the use of prescribed fire in woods for increased/enhanced deer browse has followed some level of canopy removal to increased available sunlight and plant response.

Fertilization has also been shown to affect growth and nutritional quality of deer forages, but data evaluating the effects of fertilization in closed-canopy hardwood stands are lacking. Evaluation of practices that do not alter the overstory is warranted as many landowners are interested in the effect these practices may have on browse availability and nutritional quality.

The effects of three treatments on browse production in two closed-canopy hardwood stands in Tennessee were evaluated. Treatments included prescribed fire, understory fertilization, and prescribed fire with understory fertilization. Specific objectives of this study were to:

1) determine the production of browse species following treatments;

2) determine the nutritional quality of browse species following treatments;

3) determine white-tailed deer use of browse species;

4) determine the nutritional carrying capacity for white-tailed deer following treatments.

Study Areas

To examine the effects of prescribed burning and understory fertilization on production and nutritional quality of woody leaf biomass and herbaceous forage, closed-canopy hardwood stands with no recent fire histories were chosen for this study.

Rocky River

Within the Cumberland Plateau physiographic province of Tennessee, a shortleaf pine-oak stand was selected on Rocky River Hunting Club in Sequatchie County, Tennessee. Common overstory species included scarlet oak (*Quercus coccinea*), white oak (*Quercus alba*), shortleaf pine (*Pinus echinata*), black oak (*Quercus velutina*), and mockernut hickory (*Carya tomentosa*). Midstory species included mockernut hickory, sassafras (*Sassafras albidum*), sourwood (*Oxydendrum arboreum*), blackgum (*Nyssa sylvatica*), red maple (*Acer rubrum*), pignut hickory (*Carya glabra*), and flowering dogwood (*Cornus florida*). Soils within the stand were primarily Lonewood silt loam, 2-5% slopes with a minor component of Lily loam, 6-12% slopes (Prater 2003), and characterized as well-drained and acidic. Site indices for shortleaf pine, Virginia pine (*Pinus virginiana*), and white oak on Lonewood series soils are 70, 70, and 75, respectively (Prater 2003). Infrared-triggered camera censuses conducted on this property during summer 2003 and summer 2004 indicated a minimum deer density of 28 deer/square mile.

Ames Plantation

An oak-hickory stand was selected within the Coastal Plain physiographic province at Ames Plantation in Fayette County, Tennessee. White oak, yellow-poplar (*Liriodendron tulipifera*), southern red oak (*Quercus falcata*), blackgum, and sweetgum (*Liquidambar styraciflua*) were common in the overstory. Midstory species included winged elm (*Ulmus alata*), black cherry (*Prunus serotina*), and flowering dogwood. Poison ivy (*Toxicodendron radicans*), Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), and supplejack (*Berchemia scandens*) were common in the understory. Soils within this stand were primarily Ruston sandy loam, 12-30% slopes (Flowers 1964), and characterized as well-drained and acidic. Site indices ranged from 55-80 for loblolly pine and 50-70 for shortleaf pine (Flowers 1964). An infrared-triggered camera census conducted on this property during summer 2005 indicated a minimum deer density of 21 deer/square mile.

Materials and Methods

Sixteen 100-yard transects were systematically established 100 feet apart within each stand during summer 2004. Pre-treatment data, including woody leaf biomass and herbaceous forage, were measured and collected within four sampling plots systematically placed every 25 yards along each transect. Sampling plots were five yards in length and four feet in width, thereby sampling a total of 60 ft^2 of area along each transect. Woody browse plants within the sample plot were tallied to species (stem count) and evidence of browsing noted. Browsing on herbaceous plants was noted along the line transect. For woody vines (poison ivy, Virginia creeper, and honeysuckle), a measure of

inches covered along the line transect was used to calculate a stem count estimate. Leaves of woody vegetation and all above-ground growth of herbaceous plants (≤4 feet high) were collected and sorted. Samples were placed in a forced-air oven at 50^{o}C until cessation of weight loss and then weighed to determine dry-matter weights.

Following completion of pre-treatment data collection, stands were divided into four 3.2-acre sections, each containing four of the previously established transects. Soil samples were collected along the four transects within each section and combined to form a representative sample of each section before treatment application (RR – September 23, 2004; AP – February 12, 2005). Soil samples were submitted to The University of Tennessee Soil, Plant and Pest Laboratory for analysis with the Mehlich 1 soil test.

Two sections in each stand were burned in early spring 2005 (RR – March 30, 2005; AP – April 5, 2005). Strip-heading fires were used at both sites, with flame heights approaching eighteen inches.

Fertilizer application was conducted in late spring 2005 (RR – May 16, 2005; AP – May 12, 2005) at each site. Four transects within one burned and one unburned section were fertilized with ammonium nitrate (34-0-0) at a rate of 45 lbs N/acre, while triple superphosphate (0-46-0) and muriate of potash (0-0-60) were applied with a goal of raising phosphate and potash ratings into levels where a plant response would be expected based upon soil test results (6" depth). At Rocky River, fertilizer was applied at a rate of 72 lbs phosphate/acre and 205 lbs potash/acre. In the burned section at Ames Plantation, fertilizer was applied to four transects at a rate of 52 lbs phosphate/acre and 101 lbs potash/acre. For the transects that were fertilized only at Ames Plantation, a rate of 72 lbs phosphate/acre and 131 lbs potash/acre was applied. Soil samples were also

collected in middle (RR – June 23, 2005; AP – June 16, 2005) and late summer 2005 (RR – July 28, 2005; AP – August 17, 2005) to track responses in soil pH, as well as soil phosphate and potash levels after implementation of treatments. Because fertilizer was not incorporated, soil samples from the 2" depth were used to track the effects of fertilization and are reported for each site before and after implementation of treatments.

To avoid previously sampled areas, plots during July/August 2005 were located halfway between plots sampled in 2004. Sample plots in summer 2005 were four feet wide by ten feet in length. Evidence of browsing on woody plants in sample plots was recorded during a stem tally. All woody leaves and herbaceous plants ($\leq$ 4 feet high) were collected and sorted by species or species groups (i.e., hickory, red oak, or white oak group). Samples were placed in a forced-air oven at 50^{o}C until cessation of weight loss and weighed to determine dry-matter weights. Samples of species or species groups collected within the same treatment were combined into a composite sample and ground with a Wiley mill until particles passed through a 1-mm screen. Composite samples were analyzed for nitrogen with a nitrogen analyzer (LECO FP-2000) using the Dumas combustion method. Fiber analyses (neutral and acid detergent) were conducted with a ANKOM 200 fiber analyzer.

Statistical Analysis

Browse and herbaceous forage biomass were collected both years; therefore, a CRD split-split plot design was used for the mixed model ANOVA. Burn treatment was the main plot, while fertilizer treatment and year were splits. Log or log plus 0.5 transformations were used when necessary to address normality and homogeneity of variance. When the interaction term was significant ($P<0.05$), the LSD method was used

for mean separation. To reduce the chances of making a Type I error, ten individual browse species or species groups (i.e., white oak group) were chosen for biomass analysis based on deer selectivity (see description below) and the contribution of each species/species group to total biomass at each site. Individual browse species/species group biomass was compared among treatments using a CRD split-plot design for the mixed model ANOVA. Burn treatment was main plot, while fertilizer treatment was the split. Before using the log transformation for the ten individual species/groups, 0.5 was added to all biomass values to retain observations with zero values. For testing treatment effects, a Bonferroni-corrected alpha level of 0.01 (0.10/ten species tested) was used. When significant ($P<0.01$) differences were found, the LSD method was used to detect differences among means.

Habitat use analysis was conducted on pre-treatment (2004) data using a selection index (Chesson index; Chesson 1978, 1983) to separate use of individual species or species group within the study stand at each site (4^{th}-order habitat selection; Johnson 1980). A selection index value was calculated for each species/species group having stem counts $\geq$25 at each site. In order to calculate selection index values, species/species groups with less than 25 stems were combined into an "other" category. Due to the low number of stem counts for some species within a replication (transect), it was necessary to combine stem counts across transects which prevented statistical testing of index values. Index values of 0 indicate no use, while values of 1.0 indicate exclusive use of the species/species group. Cutoff values indicating no selection between species/species groups were dependent upon the number of species/species group comparisons at each

site (Ames Plantation – 1/25=0.04, Rocky River – 1/11=0.09). Values above and below these values indicate greater and lesser use, respectively, than expected at a given site.

Estimates of nutritional carrying capacity in 2005 were calculated with the explicit nutritional constraints model (Hobbs and Swift 1985). Following criteria used by Edwards et al. (2004), carrying capacity was estimated using constraints of 12% CP and a dry matter intake of 3 lb/day for white-tailed deer. Nutritional values for individual browse species was determined by combining samples of each species collected throughout each treatment or control area. Because samples of each species within a section were combined for nutritional analyses, absolute values for crude protein, NDF, and ADF are reported. Deer forages included in the carrying capacity estimate were based upon selection indices calculated at each site. A CRD split-plot design was used for the mixed model ANOVA comparing carrying capacity estimates among treatments, with an alpha level of 0.05 used to detect treatment differences. Data were log transformed when necessary to address normality and variance problems.

Results

Rocky River

Treatments had no effect on soil pH, as they were low (4.3 to 4.6) across all treatments and sampling periods (Table 28). Soil phosphate levels increased following fertilization treatments (Table 28). Soil potash levels also increased following fertilization treatments (Table 28).

The three way interaction between burn treatment, fertilizer treatment, and year was significant ($F_{1,108}$=5.27,P=0.02) for browse biomass. Fertilization alone did not

increase browse production, but burning and burning with fertilization did increase available browse. Year effect was significant ($F_{1,114}$=11.87,P<0.01) for herbaceous forage biomass, and increases in herbaceous forage occurred in all treatments from 2004 to 2005 (Table 29).

There were various effects on biomass of individual browse species/groups following treatments (Table 30). Crude protein and fiber content varied between species/groups and treatments (Table 31).

Three species/species groups (greenbrier, blackgum, and blackberry) were used more than expected based on availability at Rocky River (Table 32). Seven species/species groups were used less than expected. No use was recorded for species in the red oak group.

Burning ($F_{1,60}$=4.44,P=0.04) and fertilization ($F_{1,60}$=4.70,P=0.03) increased carrying capacity estimates at Rocky River (Table 33). Carrying capacity estimates ranged from 3 deer days/acre in control areas to 6 deer days/acre within the burned and fertilized treatment. Carrying capacity estimates in areas burned only or fertilized only approached 5 deer days/acre.

Ames Plantation

Soil pH fluctuated somewhat among treatments (6.0-6.6), but was not influenced by treatment (Table 34). Soil phosphate and potash levels were increased following fertilization treatments but were apparently not influenced by burning (Table 34).

There was a significant interaction between burning and fertilization ($F_{1,108}$=4.68,P=0.03) for browse biomass. No treatment, however, increased browse production (Table 35). The interaction between burning, fertilization, and year was

significant ($F_{1,108}$=7.96,P=0.01) for herbaceous forage. Herbaceous forage was increased following prescribed fire and prescribed fire with fertilization (Table 35).

Treatment effects varied among individual species/species groups (Table 36). Crude protein and fiber content varied between species/groups and treatments (Table 37).

Five species/species groups (greenbrier, supplejack, blackgum, rose, and winged elm) were browsed more than expected based on availability, while the "other" category was browsed in proportion to availability at Ames Plantation (Table 38). The other 19 species/species groups were browsed less than expected based on availability. No browsing was recorded for yellow-poplar, sassafras, Carolina buckthorn (*Rhamnus carolina*), persimmon (*Diospyros virginiana*), or devil's walking stick (*Aralia spinosa*).

Fertilization did not increase ($F_{1,60}$=1.96,P=0.17) carrying capacity estimates at Ames Plantation(Table 33); however, burning decreased estimates of deer days/acre ($F_{1,60}$=6.11,P=0.02). Estimates ranged from 2 deer days/acre in burned areas to nearly 9 deer days/acre in areas that were fertilized only. Carrying capacity estimates following burning and fertilization was 4 deer days/acre, while estimates in control areas was approximately 7 deer days/acre.

Discussion

Although other studies have noted changes in pH following burning, soil test results from this study suggested burning did not change pH. Binkley (1986) observed an increase in pH following surface fires in a loblolly pine stand. Blankenship and Arthur (1999) noted increased pH in the burned organic horizons by 0.2-0.3 units following prescribed fire on a portion of the Cumberland Plateau in Kentucky. In this study, no

effect of fire on pH was measured at either study area in sections that received prescribed fire or prescribed fire with understory fertilization. While using ammonium nitrate fertilizers may lower pH if used annually, pH changes following infrequent fertilization is usually negligible (Fisher and Binkley 2000). Nonetheless, a slight decline in pH was noted at both sites following fertilization. A similar trend was not observed for sections receiving the prescribed burning with understory fertilization treatment in this study. Fire may have buffered any pH change following fertilization.

While levels of soil phosphate and potash were raised following fertilization treatments, little change in biomass of individual species/species groups was observed. Burning increased biomass of some species; however, no changes in soil phosphate and potash levels were apparent following burning. Furthermore, a cost:benefit analysis indicated understory fertilization for increased browse production in closed-canopy hardwood stands would not be cost efficient when compared to prescribed fire. Costs of fertilizers used in this study were $0.195/lb (34-0-0), $0.272/lb (0-46-0), and $0.200/lb (0-0-60). Average fertilization costs for rates of N ($17.20/acre), P ($36.66/acre), and K ($51.00/acre) applied in this study totaled $104.86/acre. When compared to the control and burn only sections, significant biomass increases following fertilization only occurred for one of the browse species selected by deer at Rocky River. An increase of four lbs/acre for blackberry results in a cost of $26.22 per pound of additional biomass in fertilized sections.

Differences in soil potash responses at Ames Plantation and Rocky River may be a result of differences in soil texture between the two sites. Treatment stands at Ames Plantation were located on a sandy loam which has a different clay content than the silt

loam at Rocky River. As the summer progressed, the greater clay content and cation exchange capacity of the silt loam soil likely contributed to the observed decline in potash ratings during the late summer sampling period as clay particles attracted more of the free potassium ions at Rocky River.

Browse species differed in their responses to treatments one growing season after burning, and responses will likely change as species recover after two or three growing seasons following fire. Lay (1956) noted reduced browse production for two years and increased herbaceous forage production for at least three years following burning, with little change in overall forage production. Wood (1988) measured forage production in loblolly pine (*Pinus taeda*) stands 3 years following a prescribed burn and suggested any increases in forage production or quality were short lived and probably small. Dills (1970) found an increase in browse production after two growing seasons following prescribed burning in a mixed pine-hardwood forest on Catoosa Wildlife Management Area. In the current study, sassafras showed highly significant biomass increases following burning treatments at Rocky River, while other species typically showed decreased production. The difference in carrying capacity estimates between sites in similar treatments is attributed to plant species composition at each site. Following burning treatments at Ames Plantation, winged elm and greenbrier biomass was reduced, which contributed to higher carrying capacity estimates in sites that were not burned. High blackgum and greenbrier biomass estimates occurred in burn treatments at Rocky River, which resulted in higher carrying capacity estimates at this site.

Fertilization may also impact production of some browse species, but responses may be limited in closed-canopy hardwoods. Segelquist and Rogers (1975) reported

increased vegetation yields of Japanese honeysuckle, but study plots were located on cleared wildlife food plots receiving lime and high levels of N fertilization (175 and 300 kg N/ha). Dyess et al. (1994) also observed increased production of honeysuckle following fertilization, but their research plots were limed and grown in an open area. While statistical differences were observed for biomass of some browse species (AP – supplejack; RR – hickory group, blackberry) following fertilization at each site in this study, biomass increases were not considered biologically significant when compared to responses after prescribed burning. No differences were observed in biomass of Japanese honeysuckle following fertilization as noted in studies conducted in open areas. In addition, no effects of fertilization on carrying capacity estimates were observed for Ames Plantation. Increases in carrying capacity estimates at Rocky River can be attributed to increases in blackberry production following fertilization. Differences in biomass and carrying capacity estimates following similar treatments at each site emphasize the importance of knowledge of flora present on a site.

Although timber harvesting may be unappealing to some landowners, research has shown increases in browse biomass following various silvicultural treatments, with biomass increasing as canopy cover is removed. In the southern Appalachians, Johnson et al. (1995) found woody plant leaf biomass in clearcut stands (935 lb/acre) was almost nine times greater than in the adjacent uncut stands (110 lb/acre). Masters et al. (1993) noted the negative relationship between forage production and overstory and found standing crop estimates were 25 times greater on harvested and burned treatments when compared to control treatments in the Ouachita Mountains. Another study in the Ouachita Mountains found a negative relationship between total standing crop of deer forage and

basal area (Masters et al. 1996). Thompson et al. (1991) found increased forage availability in the Ozark Highlands region after reductions in canopy cover following prescribed burning and herbicide treatments. Measuring varying levels of hardwood and pine basal area reduction in a natural loblolly pine-hardwood stand, Peitz et al. (1999) found total browse production increased 2 years (155-1417%) and 4 years (386-2790%) after thinning treatments, with production levels increasing as more hardwood and pine basal area was removed. Increases in biomass following hardwood basal area reduction was observed for greenbrier and supplejack, and blackberry was dominant only on areas with low pine basal areas and no hardwoods (Peitz et al. 1999). These species were identified as selected in this study and included in the calculation of carrying capacity estimates; therefore, silvicultural treatments reducing shading of these closed-canopy stands would likely increase biomass of these species and the associated carrying capacity estimates.

Results pertaining to selection of browse species in this study and past diet studies of deer in Tennessee were similar, but there were differences. Kennedy et al. (1991) found Japanese honeysuckle, poison ivy, and two greenbrier species comprised the top percentages of browse species in summer diets of deer at Ames Plantation, with browse assuming greater importance during the fall and winter. Browse comprised the greatest percentage of diets on Catoosa Wildlife Management Area (an area located within the Cumberland Plateau physiographic province northeast of Rocky River) during the summer, followed by fungi (Kennedy et al. 1991). However, deer use in that study was based on rumen samples, with no estimate of food availability at either site. Both Carlock (1969) and Kennedy et al. (1991) found greenbrier an important food for white-tailed

deer near Catoosa Wildlife Management Area. While greenbrier was a selected species at Ames Plantation and Rocky River, Japanese honeysuckle and poison ivy were not selected and were not included in carrying capacity estimates.

Past research has indicated changes in nutritional quality of browse species following burning and fertilization. Prescribed burning has been shown to increase nutritional quality (Lay 1957) and white-tailed deer utilization (Lay 1967) of browse species. Dills (1970) noted higher protein values of plant species in burned areas when compared to control areas during a June sampling, but samples collected in September showed similar protein values on burned and unburned areas. Harlow et al. (1993) observed improvement of nutritional quality of native and introduced forages following fertilization of rights-of-way in the Upper Piedmont of western South Carolina, and Wood (1986) noted an increase in phosphorus levels of deer forages following various fertilization treatments. Both Segelquist and Rogers (1975) and Dyess et al. (1994) reported increased crude protein levels in honeysuckle following liming and fertilization of plots in open areas. Furthermore, Frederick and Kennedy (1995) suggested deer may use fertilized Japanese honeysuckle plants more than unfertilized plants during winters when food quality and quantity are reduced.

Based on data collected in this study, definition of species selected (or heavily eaten) by deer may influence carrying capacity estimates more than increases in crude protein values. While crude protein values in most treatments were slightly higher than control areas (Table 31, Table 37), only control areas at Ames Plantation had reductions in carrying capacity estimates attributed to the minimum criteria for crude protein (12%) used for calculating carrying capacity estimates. Sassafras was not a selected species at

Rocky River and therefore was not included in the carrying capacity estimates. Sassafras crude protein values ranged from 14-15% across all treatments and control areas at Rocky River (Table 31), and there were significant increases in sassafras biomass in the areas that were burned only and burned and fertilized (Table 30). If sassafras was included in the calculation of carrying capacity estimates at Rocky River, significant increases in carrying capacity estimates for areas that were burned only and burned and fertilized would have occurred. Managers should use results from diet studies as general guidelines for deer use of various species and evaluate treatment effects of browse species in relation to deer use on areas they manage.

It is important for deer managers to relate estimated deer densities to the available resources within a given area. Deer densities at Rocky River were estimated at 28 deer/square mile, while carrying capacity estimates ranged from 1920 deer days/square mile in control areas to 3840 deer days/square mile in areas that were burned and fertilized. At the current density, deer at Rocky River using selected forages would have 69-137 days of quality (12% CP mixed diet) forage available within the shortleaf pine-oak forest type, depending on treatment. Deer densities at Ames Plantation were estimated at 21 deer/square mile, while carrying capacity estimates ranged from 1280 deer days/square mile in areas that were burned only to 5760 deer days/square mile in areas that were fertilized only. At the current density, deer at Ames Plantation using selected forages would have 61-274 days of quality forage available within the oak-hickory forest type, depending on treatment. Assuming forage would be produced and available from mid-April to mid-September at each site, deer would need high quality forages for 150 days. No treatment at Rocky River provided 150 days of quality forage,

indicating a need for forest management and/or creation of early successional openings and/or quality forage plantings. Most of the area where Rocky River is located (Cumberland Plateau) is heavily forested and early successional plant communities are limited in some areas. During this study, timber harvesting was occurring across a large portion of Rocky River which contributed to a higher carrying capacity for deer at this site and helped prevent overbrowsing. Timber harvests can increase forage quantity, while quality food plots can greatly increase forage quantity and quality. However, increases in browse following forest management are relatively short-lived and address dietary needs of deer primarily during the spring and summer. Harvesting should not occur across all of the landscape because a portion of mast-producing stands is needed to provide hard mast during the fall and winter.

At Ames Plantation, even the low carrying capacity treatment (burning) may provide enough quality forage for deer when considering surrounding land-use practices. Although browse comprised the greatest percentage of diets during the summer at Ames Plantation, Kennedy et al. (1991) also found forbs and agricultural crops were important foods for deer during the summer. Analyzing data collected from November 1984 to June 1986, Weckerly (1988) found browse use at Ames Plantation was negligible from April to October. Soybeans fields were in close proximity to the stand used in this study. Forage from soybeans certainly replaced a portion of deer diets which would have been comprised of browse species. Impacts of treatments must be evaluated in relation to surrounding habitat conditions.

It is also important to consider temporal changes in carrying capacity estimates because burn treatments would likely produce more forage in the second and third

growing seasons following fire. As observed by Lay (1956), browse production may be reduced for a couple of growing seasons following burning but will eventually increase to pre-treatment levels. By promoting growth within the deer's reach, carrying capacity estimates in stands used in this study were probably higher in the second and third growing seasons following burning. Continual burning may change plant composition from predominantly woody to more herbaceous. Knowing expected temporal changes in plant composition following various treatments and surrounding land-use practices allows managers to provide for habitat requirements of wildlife species across several years.

Management Recommendations

White-tailed deer occur in a variety of habitats, so managers must address the needs of this species in relation to conditions present on and around areas they manage. Prescribed burning and understory fertilization produced mixed effects in two closed-canopy hardwood stands in Tennessee one growing season after treatment. Understory fertilization in closed-canopy hardwood stands is not recommended because plant response was minimal and any small benefit would not justify the cost of fertilization. Liming before fertilization could improve pH and availability of nutrients in the fertilizer applied, but liming in forested areas is generally not practical because of the amount of lime needed to correct soil acidity, the associated costs, and the difficulty of spreading lime in the woods. Prescribed burning is more cost effective, but mixed results were observed at the two study sites. Based on work by Lay (1956), browse production of selected species should increase during the second and third growing season following

prescribed fire, which would increase nutritional carrying capacity estimates at each site. However, neither of the treatments tested in this study increased browse production appreciably and pale in comparison to the effects of canopy removal.

When private landowners and/or managers have aesthetic concerns with timber harvesting, retention cuts and thinnings should be used to open the canopy and encourage additional browse production while leaving a visually appealing stand. Soft mast production and habitat structure produced by thinnings can improve habitat for white-tailed deer and other wildlife species (Jackson et al., in press). Opening the canopy by removing/killing adjacent competitors can also enable the crowns of remaining oaks to enlarge, which can enhance acorn production (Healy 1997). By controlling herd density and identifying appropriate management practices that complement land-use practices surrounding their area, managers can ensure the nutritional needs of white-tailed deer are met throughout the year.

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Appendix

Table 28. Soil test results (two inch depth) before and after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Rocky River Hunting Club in Sequatchie County, Tennessee from September 2004-July 2005.

		Treatment[a]			
Sample date	Comparison	Control	Fert[b]	Burn	Burn/Fert[b]
September 23, 2004	pH	4.4	4.6	4.3	4.5
June 23, 2005	pH	4.3	4.4	4.4	4.6
July 28, 2005	pH	4.4	4.3	4.3	4.4
September 23, 2004	Phosphate	4	4	8	4
June 23, 2005	Phosphate	4	24	4	24
July 28, 2005	Phosphate	4	20	12	24
September 23, 2004	Potash	48	71	49	46
June 23, 2005	Potash	98	220	78	280
July 28, 2005	Potash	51	160	53	170

[a]Stands at Rocky River were burned on March 30, 2005 and fertilized on May 16, 2005.
[b]Fertilizers used and application rates were: 34-0-0 (45 lbs N/acre); 0-46-0 (72 lbs phosphate/acre); 0-0-60 (205 lbs potash/acre)

Table 29. Woody leaf biomass and herbaceous forage production (DM lbs/acre) before and after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Rocky River Hunting Club in Sequatchie County, Tennessee during summer 2004 and 2005.

		Treatment											
		Control			Fert			Burn			Burn/Fert		
Year	Comparison	$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)	
Pre-	woody leaf[a]	59.42	(7.12)	E	135.75	(18.00)	BC	108.84	(11.61)	CD	90.73	(16.85)	D
Post-	woody leaf[a]	71.42	(11.74)	E	106.39	(11.07)	CD	195.67	(23.68)	AB	232.43	(21.82)	A
Pre-	herbaceous[b]	9.50	(1.96)		13.00	(4.63)		8.20	(3.25)		10.40	(2.64)	
Post-	herbaceous[b]	13.20	(3.01)		23.40	(7.64)		18.00	(6.77)		51.00	(13.32)	

[a]Treatment effect significant (P=0.02) for woody leaf production. Means with the same letter within the woody leaf comparison are not different (P<0.05).
[b]Treatment effect not significant (P=0.61) for herbaceous forage production; year effect significant (P<0.01).

Table 30. Woody leaf biomass production (DM lbs/acre) of individual species/groups after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Rocky River Hunting Club in Sequatchie County, Tennessee during summer 2005.

	Treatment										Effect	
	Control			Fert			Burn			Burn/Fert		
Species	$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)		Burning	Fertilization
blueberry	22.11	(5.37)		35.01	(5.50)		61.87	(13.01)		42.66	(9.90)		$F_{1,12}$=0.26,P=0.62	$F_{1,12}$=0.17,P=0.69
sassafras	7.10	(1.63)		18.96	(5.20)		55.12	(10.96)		94.73	(19.51)		$F_{1,60}$=27.12,P<0.01	$F_{1,60}$=1.19,P=0.28
sourwood	5.15	(2.74)		4.10	(2.11)		39.06	(20.54)		21.81	(8.45)		$F_{1,60}$=2.48,P=0.12	$F_{1,60}$=0.18,P=0.67
greenbrier	6.80	(1.68)		7.25	(1.36)		10.25	(1.50)		7.40	(1.40)		$F_{1,60}$=1.60,P=0.21	$F_{1,60}$=1.21,P=0.28
blackberry	1.55	(0.54)		5.45	(1.68)		0.50	(0.00)		3.35	(1.36)		$F_{1,12}$=2.98,P=0.11	$F_{1,12}$=7.42,P=0.02
red maple	7.70	(2.06)		9.95	(3.86)		4.40	(2.02)		21.36	(11.30)		$F_{1,12}$=4.57,P=0.05	$F_{1,12}$=0.16,P=0.70
blackgum	1.55	(0.44)		2.60	(1.05)		4.40	(1.31)		9.65	(2.69)		$F_{1,12}$=8.14,P=0.02	$F_{1,12}$=2.23,P=0.16
red oak group[a]	4.25	(1.32)	AB	11.15	(3.56)	A	12.05	(6.04)	A	8.75	(7.94)	B	$F_{1,60}$=2.88,P=0.10	$F_{1,60}$=0.04,P=0.85
white oak group	12.80	(7.42)		7.40	(2.96)		7.70	(5.00)		8.00	(2.09)		$F_{1,12}$=0.05,P=0.82	$F_{1,12}$=1.29,P=0.28
hickory	3.65	(1.33)		7.70	(2.31)		2.00	(1.20)		9.65	(4.35)		$F_{1,60}$=1.55,P=0.22	$F_{1,60}$=5.88,P=0.02

[a]Significant burning x fertilization interaction at P<0.01. Within the row, means are not different (P<0.05) if followed by the same letter. Raw means are reported, but analysis was conducted on transformed data.

Table 31. Nutritional quality[a] of species after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Rocky River Hunting Club in Sequatchie County, Tennessee during summer 2005.

		Crude Protein (%)			
Species	Scientific name	Control	Fert	Burn	Burn/Fert
blackgum	*Nyssa sylvatica*	11.9	13.7	14.3	13.4
red maple	*Acer rubrum*	11.3	13.3	15.2	14.7
blackberry	*Rubus* spp.	13.5	14.8	--	11.9
sassafras	*Sassafras albidum*	15.2	15.1	14.9	14.0
greenbrier	*Smilax* spp.	12.6	14.9	13.3	14.3
sourwood	*Oxydendrum arboreum*	11.5	12.2	11.7	14.4
blueberry	*Vaccinium* spp.	9.4	10.6	9.7	11.0
		Neutral Detergent Fiber (%)			
Species	Scientific name	Control	Fert	Burn	Burn/Fert
blackgum	*Nyssa sylvatica*	40.5	38.3	36.7	38.8
red maple	*Acer rubrum*	44.0	41.2	39.2	43.0
blackberry	*Rubus* spp.	43.9	43.0	--	41.6
sassafras	*Sassafras albidum*	57.3	53.4	53.5	55.7
greenbrier	*Smilax* spp.	47.1	46.8	44.1	46.6
sourwood	*Oxydendrum arboreum*	39.3	38.3	37.3	39.7
blueberry	*Vaccinium* spp.	48.3	51.0	45.6	50.1
		Acid Detergent Fiber (%)			
Species	Scientific name	Control	Fert	Burn	Burn/Fert
blackgum	*Nyssa sylvatica*	20.4	26.2	16.3	21.9
red maple	*Acer rubrum*	28.3	25.4	25.3	31.7
blackberry	*Rubus* spp.	21.9	24.3	--	23.8
sassafras	*Sassafras albidum*	42.1	46.1	36.0	40.2
greenbrier	*Smilax* spp.	30.7	28.4	31.6	44.0
sourwood	*Oxydendrum arboreum*	23.8	22.2	21.8	25.1
blueberry	*Vaccinium* spp.	33.2	37.6	30.0	34.4

[a]Hyphens indicate composite sample of species collected in a given treatment was not large enough for nutritional analysis.

Table 32. Species/species groups selected by white-tailed deer at Rocky River Hunting Club in Sequatchie County, Tennessee during summer 2004.

Species	Scientific name	Selection index value[a]
greenbrier	*Smilax* spp.	0.346
blackgum	*Nyssa sylvatica*	0.263
blackberry	*Rubus* spp.	0.134
		0.091
hickory	*Carya* spp.	0.060
blueberry	*Vaccinium* spp.	0.045
red maple	*Acer rubrum*	0.032
sourwood	*Oxydendrum arboretum*	0.022
sassafras	*Sassafras albidum*	0.015
white oak group	*Fagus* spp.	0.007
red oak group	*Fagus* spp.	0.000

[a]Index values greater than 0.091 indicate selection, while values less than 0.091 indicate use less than expected.

Table 33. Carrying capacity (deer days/acre and square mile, assuming 3 lb/day consumption) of selected deer forages combined to average 12% crude protein after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in closed-canopy hardwood stands at Rocky River Hunting Club in Sequatchie County, Tennessee and Ames Plantation in Fayette County, Tennessee during summer 2005.

		Treatment								Effect	
		Control		Fert		Burn		Burn/Fert		Burning	Fertilization
Site	Deer days	$\bar{x}$	(SE)	$\bar{x}$	(SE)	$\bar{x}$	(SE)	$\bar{x}$	(SE)		
RR[a]	per acre	2.80	(0.55)	4.60	(0.76)	4.55	(0.60)	6.30	(1.21)	$F_{1,60}$=4.44,P=0.04	$F_{1,60}$=4.70,P=0.03
	per square mile	1792.00	(352.00)	2944.00	(486.40)	2912.00	(384.00)	4032.00	(774.40)		
AP[b]	per acre	6.90	(1.70)	8.50	(2.64)	2.10	(0.45)	4.20	(1.23)	$F_{1,60}$=6.11,P=0.02	$F_{1,60}$=1.96,P=0.17
	per square mile	4416.00	(1088.00)	5440.00	(1689.60)	1344.00	(288.00)	2688.00	(787.20)		

[a]Interaction between burning and fertilization not significant (P<0.05); burning increased carrying capacity and fertilization increased carrying capacity at Rocky River (RR)

[b] Interaction between burning and fertilization not significant (P<0.05); burning decreased carrying capacity and fertilization had no effect on carrying capacity at Ames Plantation (AP)

Table 34. Soil test results (two inch depth) before and after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Ames Plantation in Fayette County, Tennessee from February-August 2005.

		Treatment[a]			
Sample date	Comparison	Control	Fert[b]	Burn	Burn/Fert[b]
February 12, 2005	pH	6.3	6.4	6.1	6.2
June 16, 2005	pH	6.1	6.1	6.0	6.6
August 17, 2005	pH	6.2	6.0	6.1	6.1
February 12, 2005	Phosphate	4	4	4	12
June 16, 2005	Phosphate	4	16	4	24
August 17, 2005	Phosphate	8	28	8	28
February 12, 2005	Potash	180	140	140	160
June 16, 2005	Potash	120	200	100	240
August 17, 2005	Potash	200	300	170	300

[a]Stands at Ames Plantation were burned on April 5, 2005 and fertilized on May 12, 2005.
[b]Fertilizers used and application rates were: 34-0-0 (45 lbs N/acre); 0-46-0 (72 lbs phosphate/acre in fert and 52 lbs phosphate/acre in burn/fert); 0-0-60 (131 lbs potash/acre in fert and 101 lbs potash/acre in burn/fert)

Table 35. Woody leaf biomass and herbaceous forage production (DM lbs/acre) before and after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Ames Plantation in Fayette County, Tennessee during summer 2004 and 2005.

		Treatment											
		Control			Fert			Burn			Burn/Fert		
Year	Comparison	$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)	
2004	woody leaf[a]	162.76	(18.77)		139.35	(12.94)		140.25	(26.37)		169.06	(19.47)	
2005	woody leaf[a]	188.32	(20.47)		163.56	(22.06)		104.29	(16.07)		204.37	(30.34)	
2004	herbaceous[b]	9.60	(4.33)	BC	28.81	(8.74)	A	7.30	(3.01)	BC	1.30	(0.72)	C
2005	herbaceous[b]	13.35	(7.77)	B	21.31	(4.52)	A	15.61	(2.98)	A	49.07	(11.64)	A

[a]Treatment effect not significant (P=0.21) for woody leaf production.
[b]Treatment effect significant (P=0.01) for herbaceous forage production. Means with the same letter within the herbaceous forage comparison are not different (P<0.05).

Table 36. Woody leaf biomass production (DM lbs/acre) of individual species/groups after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Ames Plantation in Fayette County, Tennessee during summer 2005.

	Treatment											Effect	
	Control			Fert			Burn			Burn/Fert			
												Burning	Fertilization
Species	$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)		$\bar{x}$	(SE)		
poison ivy[a]	84.93	(19.04)	A	29.71	(7.26)	B	23.56	(6.13)	B	96.48	(19.04)	A	$F_{1,12}$=0.03,P=0.86	$F_{1,12}$=0.37,P=0.56
grape	10.2	(4.82)		11.7	(3.83)		16.66	(8.87)		18.31	(7.03)		$F_{1,12}$=0.22,P=0.64	$F_{1,12}$=0.84,P=0.38
Virginia creeper	9.9	(2.31)		6.9	(2.51)		11.55	(3.62)		16.66	(5.21)		$F_{1,60}$=2.53,P=0.12	$F_{1,60}$=0.08,P=0.78
ash	7.2	(2.40)		22.21	(6.40)		11.7	(5.92)		3.15	(1.35)		$F_{1,12}$=3.26,P=0.10	$F_{1,12}$=0.09,P=0.77
honeysuckle	6.6	(1.85)		16.81	(4.56)		3.3	(0.85)		5.85	(1.50)		$F_{1,12}$=2.95,P=0.11	$F_{1,12}$=2.86,P=0.12
slippery elm	11.25	(7.24)		7.05	(2.44)		7.35	(3.04)		6.15	(2.60)		$F_{1,12}$=0.11,P=0.75	$F_{1,12}$=0.08,P=0.78
blackgum	8.1	(3.36)		6.6	(5.12)		2.1	(0.90)		6.15	(3.85)		$F_{1,60}$=0.08,P=0.78	$F_{1,60}$=0.27,P=0.61
winged elm	12	(4.03)		7.2	(1.94)		3	(0.81)		0.6	(0.47)		$F_{1,12}$=9.18,P=0.01	$F_{1,12}$=2.89,P=0.12
greenbrier	6.3	(3.73)		6.9	(1.85)		1.2	(0.54)		1.5	(0.72)		$F_{1,60}$=8.89,P<0.01	$F_{1,60}$=1.25,P=0.27
supplejack	0.3	(0.30)		4.8	(1.71)		0.3	(0.30)		4.35	(1.23)		$F_{1,60}$=0.12,P=0.73	$F_{1,60}$=19.60,P<0.01

[a]Significant burning x fertilization interaction at P<0.01. Within the row, means are not different (P<0.05) if followed by the same letter.

Table 37. Nutritional quality[a] of species after implementation of understory fertilization (fert), prescribed burning (burn), and prescribed burning with understory fertilization (burn/fert) in a closed-canopy hardwood stand at Ames Plantation in Fayette County, Tennessee during summer 2005.

		Crude Protein (%)			
Species	Scientific name	Control	Fert	Burn	Burn/Fert
ash	*Fraxinus* spp.	12.4	12.8	14.5	15.2
blackgum	*Nyssa sylvatica*	10.8	11.6	13.5	13.1
Jap. honeysuckle	*Lonicera japonica*	12.6	11.7	13.3	12.1
poison ivy	*Toxicodendron radicans*	12.2	11.8	13.4	12.4
greenbrier	*Smilax* spp.	12.6	13.2	12.7	14.4
supplejack	*Berchemia scandens*	--	13.0	--	15.0
Virginia creeper	*Parthenocissus quinquefolia*	10.4	10.4	12.6	11.8
grape	*Vitis* spp.	12.4	11.4	13.6	13.2
winged elm	*Ulmus alata*	12.8	12.7	15.8	17.7
		Neutral Detergent Fiber (%)			
Species	Scientific name	Control	Fert	Burn	Burn/Fert
ash	*Fraxinus* spp.	56.6	57.3	58.7	54.5
blackgum	*Nyssa sylvatica*	37.9	38.5	37.7	37.0
Jap. honeysuckle	*Lonicera japonica*	38.8	37.0	35.9	35.8
poison ivy	*Toxicodendron radicans*	45.1	45.0	48.5	46.4
greenbrier	*Smilax* spp.	50.2	48.8	50.4	45.2
supplejack	*Berchemia scandens*	--	50.8	--	42.6
Virginia creeper	*Parthenocissus quinquefolia*	47.7	42.9	40.9	40.5
grape	*Vitis* spp.	45.4	41.1	41.5	40.3
winged elm	*Ulmus alata*	68.2	64.0	66.9	62.0
		Acid Detergent Fiber (%)			
Species	Scientific name	Control	Fert	Burn	Burn/Fert
ash	*Fraxinus* spp.	38.7	38.4	40.3	39.8
blackgum	*Nyssa sylvatica*	21.9	21.2	23.4	22.2
Jap. honeysuckle	*Lonicera japonica*	26.7	24.5	26.1	25.9
poison ivy	*Toxicodendron radicans*	29.7	30.8	32.8	32.9
greenbrier	*Smilax* spp.	30.4	29.9	35.0	34.0
supplejack	*Berchemia scandens*	--	20.7	--	25.0
Virginia creeper	*Parthenocissus quinquefolia*	32.9	33.7	30.4	32.7
grape	*Vitis* spp.	33.1	33.2	32.5	29.2
winged elm	*Ulmus alata*	28.2	31.0	29.8	23.8

[a]Hyphens indicate composite sample of species collected in a given treatment was not large enough for nutritional analysis.

Table 38. Species/species groups selected by white-tailed deer at Ames Plantation in Fayette County, Tennessee during summer 2004.

Species	Scientific name	Selection index value[a]
greenbrier	*Smilax* spp.	0.243
supplejack	*Berchemia scandens*	0.198
blackgum	*Nyssa sylvatica*	0.106
rose	*Rosa* spp.	0.082
winged elm	*Ulmus alata*	0.074
cutoff		0.040
slippery elm	*Ulmus rubra*	0.039
sugar maple	*Acer saccharum*	0.031
blackberry	*Rubus* spp.	0.030
red oak group	*Fagus* spp.	0.028
black cherry	*Prunus serotina*	0.025
white oak group	*Fagus* spp.	0.020
Eastern redbud	*Cercis canadensis*	0.018
red maple	*Acer rubrum*	0.018
hickory	*Carya* spp.	0.013
grape	*Vitis* spp.	0.009
Jap. honeysuckle	*Lonicera japonica*	0.008
ash	*Fraxinus* spp.	0.007
Virginia creeper	*Parthenocissus quinquefolia*	0.005
poison ivy	*Toxicodendron radicans*	0.002
yellow-poplar	*Liriodendron tulipifera*	0.000
sassafras	*Sassafras albidum*	0.000
Carolina buckthorn	*Rhamnus Carolina*	0.000
persimmon	*Diospyros virginiana*	0.000
devil's walkingstick	*Aralia spinosa*	0.000

[a]Index values greater than 0.040 indicate selection, while values less than 0.040 indicate use less than expected.

IV. HUNTER CHARACTERISTICS, SATISFACTION, AND ATTITUDES TOWARD DEER MANAGEMENT IN TENNESSEE

Abstract

To determine hunter characteristics, satisfaction, and attitudes toward deer management, three groups (club hunters, sportsman license holders, WMA hunters) of hunters were surveyed following the 2004-05 deer hunting season in Tennessee. Hunter surveys indicated most were "somewhat satisfied" with deer management in Tennessee, but 24% continued to hunt white-tailed deer in other states as well. The majority of club hunters (55.5%) and plurality of sportsman license holders (36.9%) and WMA hunters (34.7%) favored a statewide limit of two bucks, and the majority of club hunter (72.8%), sportsman license holders (64.1%), and WMA hunters (57.7%) favored implementing antler restrictions statewide. Experiencing nature was an important motivation for deer hunting across hunter groups.

Most club hunters (80.7%), sportsman license holders (74.7%), and WMA hunters (76.2%) regarded themselves "somewhat knowledgeable" with QDM and the majority (95.8%) considered it a sensible management philosophy. The majority of club and WMA hunters felt QDM restrictions were working and they planned to apply to hunt at that area the following season. Hunter attitudes indicated support for typical harvesting practices in a QDM program. Most club hunters (68.6%), sportsman license holders (55.1%), and WMA hunters (56.3%) felt bucks should be at least 3 ½ years old before harvest. While only 5.8% of club hunters favored the intentional harvest of spikes, over 20% of sportsman license holders and WMA hunters favored this practice. Additionally, most hunters (94.3%) favored including does in the harvest. The majority of club hunters (94.8%), sportsman license holders (91.4%), and WMA hunters (86.9%) felt buck fawns

should be protected from harvest. The relatively low percentage of buck fawns in the antlerless harvest and beliefs held by club members suggested educational programs at clubs were effective, but increased educational efforts are needed on all areas to increase program success.

Introduction

Hunter attitudes and characteristics influence white-tailed deer *(Odocoileus virginianus*) management programs. Deer managers typically depend on hunter harvest to obtain management goals, and hunter satisfaction has a considerable influence on harvest levels. Therefore, hunter satisfaction is an important consideration for deer managers. While most of the previous research investigating deer hunter satisfaction has involved traditional deer management, recent research has focused on satisfaction associated with quality deer management (QDM) programs (Woods et al. 1996). Quality deer management is not for everyone, especially when QDM restrictions are forced through regulations (Greene and Stowe 2000). Nonetheless, QDM practitioners have indicated management involvement influences their satisfaction with QDM, even more so than buck sign and sightings, deer herd quality, knowledge, hunter conduct, and image to non-hunters (Woods et al. 1996). This type of attitude deviates from traditional deer hunters and may justify recognizing them as a specific type or group of deer hunters (Applegate et al. 2002). Because QDM emphasizes hunters as managers, there is an increased importance placed on ethics and educational efforts (Wegner 1995), which likely produces a subgroup of deer hunters with a higher interest in deer management.

Tennessee currently has several public lands (Wildlife Management Areas) with regulations following the QDM philosophy, and several tracts of private land within Tennessee are also managed following QDM guidelines. However, little information has been collected to determine motivations and attitudes of hunters participating in these programs. As interest and public involvement with QDM continue to increase, it is most important for wildlife managers to understand the attitudes and motivations of this growing subgroup of hunters. Further, it is important to differentiate the attitudes and motivations of those hunters participating on public lands with those participating on private lands.

Survey Population and Objectives

Hunters from four clubs (Ames Plantation, Jasper Mountain, Myers Cove, and Rocky River) and three WMAs (Catoosa, Oak Ridge, and Yuchi Refuge at Smith Bend) with an antler restriction, as well as sportsman license holders in Tennessee, were chosen for this study.

Hunters could obtain membership in either of the four clubs after a preliminary check for past hunting violations and by signing an application/contract detailing guidelines/regulations of the QDM program and payment of an annual fee. Ames Plantation is a 18,653-acre property in Fayette and Hardeman Counties with a lease price of $1250 and a minimum score restriction of 110” to protect bucks <3 ½ years old from harvest. The remaining clubs were all located on or near the Cumberland Plateau and had similar score restrictions (100” minimum to protect bucks <3 ½ years old). Myers Cove is a 2,431-acre private property in Warren County with an annual fee of $650. Both

Jasper Mountain (8,588-acre private property in Marion County) and Rocky River (4800-acre private property in Sequatchie, Van Buren, and Warren Counties) had an annual fee of $525. An annual doe harvest goal was set for all clubs, depending on estimated deer populations of each area.

WMA hunters were drawn for quota hunts at a given area. During the 2004-05 season, Oak Ridge (37,000 acres in Roane and Anderson Counties) and Yuchi (2,364 acres in Rhea County) WMAs had antler restrictions that required antlered bucks have four or more one-inch antler points on one side of the rack or an outside antler spread of 15 inches or larger. Antlered bucks legal for harvest on Catoosa WMA (79,740 acres in Cumberland and Morgan Counties) during the 2004-05 season were required to have four or more one-inch antler points on one side of the rack. Deer hunting at Oak Ridge and Yuchi Refuge was by quota hunts only, while Catoosa offered a mixture of quota and nonquota (open to all hunters that obtain appropriate licenses/permits) hunts. Except for sportsman license holders, quota hunt applicants were required to pay a fee for every hunt they were successfully drawn for on these WMAs.

Sportsman license holders were surveyed as a representation of hunters in Tennessee. These hunters are an important segment of the deer hunting population because they comprise 85% of WMA quota hunt applicants. During fiscal year 2004-05, this group comprised 32% of license sales and contributed over $6 million in revenue (TWRA unpublished data). Sportsman license holders also accounted for 43% of the statewide deer harvest and 58% of the WMA harvest during the 2004-05 season (TWRA Big Game Harvest Report 2004-05). Specific objectives of this study were to:

1) describe characteristics of hunter groups;

2) determine satisfaction of hunter groups;

3) determine attitudes of hunter groups toward various QDM practices.

Survey Methodology

A mail survey was used to question hunters about deer hunting and management, QDM, and their demographic characteristics. Twelve-page questionnaires were sent to most hunters; however, members of multiple clubs (i.e., Jasper Mountain, Myers Cove, and Rocky River) received longer (20 page) questionnaires that contained a separate section pertaining to each club they joined.

A census of club members was conducted following the 2004-05 season, while a sample of hunters was drawn for quota hunts at each WMA. Using simple random sampling, a sample size of 384 hunters was needed for each WMA. After correcting the sample sizes with a finite population correction factor and an assumed 40% response rate (Kalton 1983; Henry 1990), samples of 1,000 (Catoosa), 900 (Oak Ridge), and 299 (Yuchi) were drawn (Table 39). Additionally, a random sample of 2004-05 sportsman license holders were surveyed to measure attitudes likely to be more similar to the general hunting population in Tennessee. A response rate of 25% was assumed, and 1,422 surveys were mailed to sportsman license holders (Table 39).

Hunters were divided into three groups (club, sportsman, and WMA) for statistical comparisons of demographic characteristics, questions pertaining to deer hunting in Tennessee, QDM, and rankings of reasons for deer hunting. Categorical data were analyzed using Pearson Chi-Square tests, with hunters responding “don’t know” excluded from analyses. An alpha level of 0.05 was used to detect differences among

hunter types, while an adjusted residual value of +/- 2 indicated tendencies between groups. Because there was a significant (Wilks' $\lambda < 0.001$) difference in the two-factor repeated measures ANOVA between hunter groups when ranking the reasons for hunting deer, reasons for hunting deer were analyzed separately within hunter groups using a single factor repeated measures ANOVA. An alpha level of 0.05 was used to indicate differences with a Bonferroni adjustment used for multiple comparisons. For questions specific to individual study populations and areas, descriptive statistics or Pearson Chi-Square tests were used when appropriate. Responses to open-ended questions were analyzed within the WordStat 5.0 content analysis module ran within the QDA Miner software program. Using the phrase finder function within WordStat, phrases with a minimum of two words and frequency greater than 3 occurrences were classified into appropriate categories within dictionaries.

Results

Using a modified Dillman survey method (survey, reminder, survey), the first wave of survey mailings occurred June 24-28, 2005. Along with the questionnaire, a cover letter and postage-paid return envelope were sent to hunters. The cover letter explained the study and the importance of each hunter's response. Two weeks later, hunters not responding to the initial mailing were sent a reminder card/thank-you letter. After another two weeks, a second survey, cover letter, and postage-paid return envelope were sent to hunters who had not responded to either of the previous mailings.

A total of 2,084 surveys were returned for an overall response rate of 55% (Table 39). Response rates ranged from 73% for members of Ames Plantation Hunting Club to

51% for sportsman license holders. Most sportsman license holders (95.8%) reported hunting white-tailed deer in TN, with 98.9% hunting at least one day during the 2004-05 season. The majority of club (89.3%) and WMA hunters (80.2%) reported hunting on each of their respective study areas during the 2004-05 season.

Hunter demographics

The average age of the survey participants was 44. The majority of hunters were male (98.1%) with no differences (P=0.534) between hunter groups (club, sportsman, and WMA; Table 40). Responses to highest level of education completed differed (P<0.001) between hunter groups (Table 41). The plurality of club hunters (34.5%) listed some college as the highest level of education completed, while the plurality of sportsman license holders (33.0%) and WMA hunters (31.7%) were high school graduates or GED recipients. Although the plurality of each hunter group lived in a rural area (but not on a farm), differences (P<0.001) existed between hunter groups, with club hunters tending to live in urban areas (Table 42). Differences (P<0.001) between hunter groups were also detected for their 2004 household income levels, with club hunters reporting higher income levels (Table 43).

General hunting questions

Hunter groups differed (P=0.008) in their preference for shooting antlered bucks, does, or fawns; however, the majority of club hunters (78.2%), sportsman license holders (71.9%), and WMA hunters (75.8%) preferred to shoot antlered bucks (Table 44). Fawns were excluded from the analysis due to low frequency (n=1). The majority (72.3%) of hunters said a "quality" buck and a "trophy" buck were not the same thing (Table 45).

Hunters differed ($P<0.001$) in their responses to the number of antlered bucks that should be allowed per individual in the Tennessee state bag limit, with the majority of club hunters (55.5%) and plurality of sportsman license holders (36.9%) and WMA hunters (34.7%) choosing two antlered bucks (Table 46). Hunter types differed ($P<0.001$) as to whether antler restrictions should be implemented statewide in Tennessee. Club hunters (72.8%) were more likely to say antler restrictions should be implemented statewide in Tennessee, compared to sportsman license holders (64.1%) and WMA hunters (57.7%; $P<0.001$; Table 47).

Tennessee's deer herd

The majority of sportsman license holders (55.6%) and WMA hunters (51.9%) indicated genetics was a "problem" for the deer herd on many properties in Tennessee, compared to only 25.8% of club hunters (Table 48). Hunter groups differed ($P<0.001$) when asked about overpopulation, with 64.9% of WMA hunters, 51.0% of club hunters, and 48.2% of sportsman license holders indicating Tennessee's herd was not overpopulated (Table 49). The majority of club hunters (89.3%), sportsman license holders (65.2%), and WMA hunters (67.1%) thought the age structure of the deer herd over most of Tennessee was not balanced, but club hunters were much more likely to hold this belief (Table 50). While the majority of club hunters (71.7%) and sportsman license holders (68.6%) felt adequate nutrition was available to deer over most of Tennessee, WMA hunters (60.8%) were not as strong in this belief ($P=0.001$; Table 51). Most club hunters (54.3%), sportsman license holders (68.0%), and WMA hunters (71.7%) felt available food resources influenced deer weight most in Tennessee, but responses differed ($P<0.001$) between hunter types as club hunters were also more likely

to say deer herd management (36.4%) than sportsman license holders (25.7%) or WMA hunters (22.7%; Table 52).

Satisfaction levels with TWRA's statewide deer management strategy were quite similar (P=0.209) across hunter types (Table 53), with the majority of hunters (54.6%) at least somewhat satisfied with the statewide deer management strategy. Almost one in four hunters indicated they hunted in another state during the 2004-05 season, but there was no difference (P=0.087) between hunter groups (Table 54). Of the 662 categorized responses to what states were hunted (Table 55), 19.3% of hunters reported hunting in Kentucky, followed by Ohio (11.4%), Illinois (11.2%), Alabama (10.2%), and Virginia (10.3%). Hunting "big" or "trophy" deer (56.0%) was the main reason for hunting deer in another state (Table 56).

Knowledge of quality deer management

Although hunter groups differed (P<0.001), the majority of club hunters (80.7%), sportsman license holders (74.7%), and WMA hunters (76.2%) rated themselves as somewhat knowledgeable of QDM, with 17.0%, 12.1%, and 12.8% of club hunters, sportsman license holders, and WMA hunters, respectively, considering themselves very knowledgeable (Table 57). Hunters at least somewhat knowledgeable with QDM were asked a series of questions pertaining to QDM. Of the hunters who rated themselves at least somewhat knowledgeable with QDM, the majority (95.8%) thought it was a sensible management philosophy (Table 58).

There was no difference (P=0.118) between hunter groups when hunters were asked how long it should take before QDM objectives are realized after initiating a QDM program (Table 59). Overall, hunters were divided into two groups: one believing three

years or less (32.6%) and the other believing five years (32.5%). Nineteen percent listed the buck:doe ratio as the most important objective of QDM (Table 60), followed by 16.4% who listed objectives relating to herd quality and health were most important, and 15.6% who listed objectives describing antlers and buck quality. Responses involving nutrition or food resources comprised 15.0% of responses. Most hunters listed the primary benefit of a QDM program a healthier herd (38.0%) and buck quality (36.5%).

Hunter groups differed (P=0.008) when asked how old a buck should be before it is "legal" to harvest in a QDM program (Table 62). The majority of club hunters (68.6%), sportsman license holders (55.1%), and WMA hunters (56.3%) responded 3 ½ years old, with club hunters more likely to choose this age class than the other types. Club hunters (9.9%) were less likely to choose 4 ½ years old when compared to sportsman license holders (19.1%) and WMA hunters (14.6%).

Hunter groups also differed (P<0.001) when asked what is the best antler restriction in a QDM program (Table 63). Due to the low frequency (n=2), the circumference restriction choice was excluded from analysis. WMA hunters (58.7%) were more likely to choose antler point when compared to club hunters (11.4%) and sportsman license holders (49.5%), and club hunters were less likely (1.8%) to select a one-buck limit instead of an antler restriction when compared to WMA hunters (16.6%) and sportsman license holders (16.6%). Club hunters (65.7%) were more likely to choose gross score when compared to sportsman license holders (2.7%) and WMA hunters (1.2%). Sportsman license holders (23.9%) were more likely to think the restriction should be dependent on the average characteristics of bucks in that area when compared to club (18.7%) and WMA (16.8%) hunters.

Hunter groups differed ($P<0.001$) when asked what was the most important factor in the success of a QDM program (Table 64). Club hunters (61.6%) were more likely to think age was most important when compared to sportsman license holders (37.2%) and WMA hunters (35.7%). WMA hunters (35.2%) were more likely to choose nutrition as the most important factor when compared to club hunters (22.7%) and sportsman license holders (32.6%). Club hunters (15.7%) were less likely to choose genetics when compared to sportsman license holders (30.1%) and WMA hunters (29.0%).

The majority of hunters (86.1%) expected deer to weigh more on QDM properties (Table 65). While the majority of club hunters (90.6%), sportsman license holders (76.4%), and WMA hunters (77.3%) preferred to hunt areas under QDM restrictions, club hunters were more likely to prefer hunting these areas when compared to the other hunter types ($P<0.001$; Table 66).

Attitudes toward various harvesting practices in a QDM program

Club hunters (94.2%) were more likely to respond spikes should not be killed intentionally when compared to sportsman license holders (77.1%) and WMA hunters (76.8%; $P<0.001$; Table 67). Hunter types differed ($P<0.001$) when asked if older bucks with poor racks should be culled (Table 68). Sportsman license holders (83.1%) were more likely to think older bucks with poor racks should be culled when compared to club (49.3%) and WMA (68.8%) hunters. There was no difference ($P=0.068$) between hunter types when asked if does should be included in the harvest, with the majority of hunters (94.3%) supporting doe harvest (Table 69). The majority of club hunters (94.8%), sportsman license holders (91.4%), and WMA hunters (86.9%) thought buck fawns should not be "legal for harvest," but WMA hunters were more likely to think buck fawns

should be legal when compared to club hunters and sportsman license holders ($P<0.001$; Table 70). Club hunters (50.0%) were more likely to think doe fawns should be "legal for harvest" when compared to sportsman license holders (31.3%) and WMA hunters (26.9%, $P<0.001$; Table 71).

Hunter motivations

Within the three hunter groups, significant (Wilks' $\lambda < 0.001$) differences were found between reasons for hunting deer (Table 72). Although not different from a place to hunt, experiencing nature was the highest ranked reason for club hunters. The least important reasons to hunt deer for club hunters were to shoot deer and deer population reduction. Sportsman license holders considered experiencing nature and the challenge of the hunt as the most important reasons to hunt deer, while the least important reason was to shoot deer. Experiencing nature and to kill a buck with a large rack was considered the most important reasons for WMA hunters, and deer population reduction was considered the least important reason.

Study area questions and comparisons

Most club hunters (65.9%) and sportsman license holders (58.2%) did not hunt deer on any WMAs during the 2004-05 season (Table 73). Most WMA hunters (62.3%) only reported hunting on the WMA on which they were drawn, with some listing ways to improve deer hunting on these areas. Hunters at Catoosa WMA felt planting food plots (15.7%), killing more does (6.2%), and lowering hunting pressure (5.4%) would improve deer hunting (Table 74). Planting food plots (13.4%), holding more hunts (6.3%), and better access (4.7%) received the most responses from Oak Ridge hunters (Table 75).

Hunters at Yuchi WMA thought planting food plots, killing more does, and holding more hunts were needed (Table 76).

There was a difference ($P<0.001$) between study areas when hunters compared the number of bucks seen on each study area to the number of bucks seen on properties managed under traditional deer management guidelines (Table 77). Hunters at Ames Plantation (79.1%) and Yuchi Refuge (58.3%) saw more bucks on the study areas, while Oak Ridge WMA hunters (33.6%) saw the same number of bucks at the study area. Catoosa WMA hunters saw fewer bucks on this study area when compared to areas under traditional deer management. Overall, the plurality of hunters (42.4%) saw more bucks at the study areas.

Hunter groups differed ($P=0.018$) when asked if QDM restrictions at each area were working toward their goal (Table 78). Ames Plantation hunters (100%) were most likely to think restrictions were working. Although the majority of hunters at Catoosa WMA (83.8%) thought the restrictions were working, these hunters were more likely to think the restrictions were not working toward their goal when compared to hunters at other study areas. Overall, most hunters (86.9%) thought the restrictions were working.

Hunters groups differed ($P<0.001$) when asked if the deer herd at each study area was overpopulated (Table 79). Yuchi Refuge hunters (45.1%) were more likely to feel the deer herd was overpopulated when compared to hunters at the other study areas. Hunters at Catoosa WMA (90.1%) and Rocky River (98.0%) were most likely to feel the deer herd at their area was not overpopulated.

Hunter groups differed ($P<0.001$) when asked if adequate nutrition was available (Table 80). Yuchi Refuge (90.6%) and Ames Plantation (97.9%) hunters were more

likely to think adequate nutrition was available. Catoosa WMA (42.4%) hunters were more likely to think adequate nutrition was not available.

When asked if they plan to hunt deer at the study area next hunting season, hunter groups differed ($P<0.001$, Table 81). Hunters at Myers Cove (90.0%) and Jasper Mountain (30.0%) were more likely to not plan on hunting at their areas next season when compared to hunters at other study areas. Yuchi Refuge hunters (94.8%) were more likely to plan on applying to hunt at this study area next season when compared to hunters on other areas.

Hunter groups differed ($P<0.001$) when comparing those that hunted public areas and private land. Hunters at Ames Plantation (only 17.3% hunted public areas) were less likely to hunt public areas when compared to hunters at the other areas (Table 82). Hunters at Rocky River, Jasper Mountain, and Ames Plantation were more likely to have not hunted other private lands during the 2004-05 season (only 50.0%, 50.9%, and 51.9% hunted on private land) when compared to hunters at other areas (Table 83). Sportsman license holders were more likely to hunt private lands (91.0%) when compared to hunters at the study areas.

When asked to rate the quality of hunting (worse, about the same, better), mean ratings for public areas (Wolf River, Laurel Hill) and private lands (Fayette and Hardeman Counties) near Ames Plantation received lower ratings than this study area (Table 84). Prentice Cooper received a lower rating than Jasper Mountain, while mean ratings for Franklin and Marion Counties were higher than this area (Table 85). Hunters at Myers Cove rated the quality of hunting in Sequatchie County higher than this area (Table 86). Rocky River hunters rated the quality of hunting at AEDC and Woods

Reservoir lower than Rocky River, but private lands in Sequatchie County received a higher rating than this area (Table 87). Oak Ridge hunters considered the quality of hunting at Bridgestone/Firestone better than Oak Ridge, while they considered hunting at Oak Ridge better than Catoosa WMA, Prentice Cooper, Mt. Roosevelt, and Chickamauga (Table 88). The quality of hunting at Oak Ridge was considered slightly better than surrounding Roane and Anderson Counties (Table 89). Similar to Oak Ridge hunters, Catoosa hunters rated the quality of hunting at Oak Ridge better than Catoosa WMA (Table 90). Quality of hunting at Catoosa was rated better than Prentice Cooper, Mt. Roosevelt, and Cordell Hull WMA (Table 90). Catoosa hunters considered the quality of hunting on private lands in Cumberland and Morgan Counties better than hunting on Catoosa WMA (Table 91). Yuchi Refuge hunters considered the quality of hunting at Catoosa and Prentice Cooper worse than this area (Table 92). Quality of hunting in Meigs County was rated about the same as Yuchi Refuge, while hunting in Rhea County was considered worse (Table 93).

Discussion

Hunter demographics

Most hunters in this study were male (98%) with an average age of 44 years. This is consistent with other studies that have identified a need to recruit more women and young people into the hunting population (Enck et al. 2000). Responses from club hunters indicated this group was more educated in deer management than WMA hunters and sportsman license holders, probably a result of educational efforts (i.e., club meetings, guest speakers, informational posters at check-in stations) at the clubs. WMA

hunters were apparently seeking opportunities to hunt areas with antler restrictions because these areas provided a better opportunity to harvest a large-antlered buck when compared to private lands they hunted.

General hunting questions

It is not surprising that hunters preferred shooting antlered bucks; however, it is interesting that nearly 75% of the hunters said a "quality" buck and a "trophy" buck were not the same thing. Greene and Stowe (2000) identified trophy deer management as a subset of QDM and stressed the importance of distinguishing the two, because trophy deer management will likely be met with opposition by the non-hunting public. It is important for hunters (especially those on WMAs) to recognize the difference between the two management philosophies so expectations in QDM programs are realistic.

The tendency for club hunters to choose two antlered bucks may be a reflection of the regulations on club properties (only two antlered bucks allowed per individual on these properties). WMA hunters showed a tendency to favor the three buck limit in place during the 2004-05 season, while sportsman license holders were more likely to favor an increase of the statewide antlered buck limit when compared to the other types. The plurality of Tennessee hunters (39.1%; n=315) surveyed by Didier et al. (2005) felt the statewide buck bag limit should be 3 bucks.

It is important to note the high percentage of hunters supporting a statewide antler restriction. Harvest criteria should be based on local herd conditions to avoid killing larger-antlered younger bucks, as yearlings have various antler characteristics (spike or multiple points) depending on local herd and habitat conditions (Hamilton et al. 1995a). Strickland et al. (2001) found lesser antler scores in older age classes when running a

simulation model that selectively removed larger-antlered younger males and noted a decline in cohort antler size in one soil resource region of Mississippi following implementation of a 4-point selective harvest criterion. This finding suggests a need for educational efforts explaining the potential negative effects of selective-harvest criteria not based on regional, age-specific antler size (Strickland et al. 2001).

Tennessee's deer herd

Hunters displayed misconceptions regarding Tennessee's deer herd. A fair number of hunters felt genetics was a problem for Tennessee's deer herd. Rarely is genetics the cause of small bucks. Instead, poor nutrition and heavy harvest of younger bucks are usually the causes (Brothers and Ray 1998a). Large-antlered bucks are common when bucks are allowed to gain age, and genetics and nutrition cannot be expressed until age is attained. Educational efforts probably helped club hunters realize genetics were not a problem and that a heavy harvest of younger deer in the past has resulted in an unbalanced age structure for Tennessee's deer herd.

Satisfaction with TWRA's deer management strategy (54.6%) reported in this study was lower than expected. When asked about satisfaction with TWRA's management of deer hunting programs, 80.0% of hunters surveyed by Didier et al. (2005) expressed satisfaction. From 1992-2005, Tennessee deer hunters have reported satisfaction levels ranging from 80.0% (2004-05 season – same season as this survey) to 86.7% (1996-97 season) (Becky Stephens unpublished data). Possible causes for discrepancy are differences in survey methodology (phone vs. mail surveys) or because this survey was presented in the context of QDM.

Although most hunters were somewhat satisfied with the current statewide deer management, a fair percentage (24%) were willing to incur additional expense (i.e., travel costs, license fees in other states) to hunt white-tailed deer in other states. The plurality of club hunters and majority of sportsman license holders and WMA hunters indicated larger-antlered deer as the reason for hunting in other states. While increased antler size is not the sole benefit of QDM programs, an increased buck age structure on QDM areas provides opportunities for these hunters.

Knowledge of quality deer management

The fact most hunters felt they were at least somewhat knowledgeable with quality deer management is undoubtedly influenced by the attention QDM receives in hunting magazines and television programs. Hunters did not have unrealistic expectations in the time required before QDM objectives were realized. Hamilton et al. (1995b) noted it may take 5 years or more before results are seen in a QDM program. The amount of time required to meet these objectives are dependent on existing herd and habitat conditions of an area and how QDM guidelines are implemented, as well as hunter acceptance and cooperation with QDM guidelines. Because hunters were split evenly at 5 years, managers should stress to hunters the importance of following guidelines and having realistic expectations for a particular area.

To correct skewed sex ratios and increase buck age structure, young bucks should be protected from harvest. While the majority of each hunter type chose the 3 ½ year-old age class as the minimum "legal" age for buck harvest, the tendency for club hunters to be more likely to chose 3 ½ is probably a reflection of the club meetings held each year. Members were informed of club regulations and goals, which included protecting bucks

less than 3 ½ years old from harvest. WMA hunters were likely not aware of the goals of programs on each respective study area. The differences in what hunters felt were the best antler restrictions were likely a result of club meetings as well. Data indicated gross score restrictions would provide the best protection for bucks less than 3 ½ years old on club properties; therefore, club hunters were instructed on how to estimate gross scores at club meetings, which likely influenced their choice for a gross score restriction. Similarly, the opinions of sportsman license holders and WMA hunters were probably influenced by the information regarding antler restrictions contained in the annually published hunting guide for Tennessee. Antler restrictions at the WMAs included in this study were antler point and/or spread restrictions, which likely caused the high preferences for the antler point category. Nonetheless, it is important to note a percentage of WMA hunters (17%), club hunters (19%), and sportsman license holders (24%) felt the restrictions should be dependent upon the average characteristics of bucks in that area, which indicates they realize the importance of restrictions based on local herd characteristics.

It appeared the decreased tendency for club hunters to prefer a 1-buck limit suggests club hunters are comfortable with a two-buck limit. The other hunter types may be more concerned with their individual chances of harvesting bucks with a higher perceived density of hunters, which likely raises support for 1-buck limits and increases opportunities for buck harvest by several individuals.

The tendency for club hunters to feel age was the most important factor in the success of a QDM program is also a reflection of club meetings expressing the importance of correcting the age structure in herds that have received heavy yearling

buck harvests in the past. WMA hunters were not only more likely to feel nutrition was the most important factor, they also felt nutrition was limiting on WMAs.

It is a common perception that where QDM is practiced, deer should be larger. In southeastern Oklahoma, Ditchkoff et al. (1997) reported an increase in average weights of bucks and does harvested on McAlester Army Ammunition Plant following QDM, as well as weight increases by specific sex-age classes of white-tailed deer. These improvements were attributed to a management program that encouraged doe harvest which lowered and maintained the deer herd below nutritional carrying capacity. Although antler restrictions can address problems with skewed sex ratios, antler restrictions alone will not achieve changes in average weights. Reducing deer numbers in overpopulated areas and/or increasing nutrition with appropriate habitat management practices is often required to see changes in average deer weights.

The strong preference of hunters for hunting areas under QDM restrictions suggests a need for TWRA (and other state wildlife agencies) to continue providing QDM areas to increase hunter opportunities and satisfaction. Beginning with the 2007-08 season, Oak Ridge WMA will no longer be under QDM restrictions, resulting in a lost opportunity for hunters preferring to hunt areas under QDM restrictions. Providing QDM opportunities within a reasonable driving distance (1 ½ hours) will help increase satisfaction of hunters preferring these areas.

Attitudes toward various harvesting practices in a QDM program

Hunter feelings on harvesting practices in a QDM program also showed tendencies that were likely a result of club meetings. Club hunters were less likely to support culling spikes, which indicates these hunters realize spikes are typically young

(yearling) deer that have not had an opportunity to grow antlers characteristic of older age bucks and that they are not necessarily genetically "inferior" (Brothers and Ray 1998b). Furthermore, club hunters were less likely to support culling older bucks with poor racks, which indicates they may better understand the goals of QDM versus trophy deer management (TDM) and how the concept of TDM is fundamentally flawed in areas where landholdings are not large (McCoy et al. 2005, Webb et al. 2007). Culling should be avoided in a QDM program, as most "culls" are typically younger bucks that could have developed into quality animals (Hamilton et al. 1995a). The scale at which deer use the landscape can make management objectives difficult to achieve, but forming QDM cooperatives can help protect younger bucks on neighboring properties.

Most hunters apparently realized the importance of an adequate doe harvest to correct sex ratio problems and lower herd density in areas where appropriate. At club meetings, hunters were informed of the importance of protecting buck fawns (button bucks), while still ensuring an adequate doe harvest. The tendencies of club hunters to be more protective of buck fawns and more likely to feel doe fawns should be legal for harvest are likely a reflection of educational efforts directed toward this group of hunters.

Hunter motivations

Out of seven determinants for explaining overall satisfaction with deer hunting at Big South Fork National River and Recreation Area, Hammitt et al. (1990) found the best predictor was a natural outdoors dimension. Grilliot and Armstrong (2005) classified the majority of Alabama hunters as nature seekers, and the plurality of Black Hills deer hunters surveyed by Gigliotti (2000) identified themselves as nature hunters. Decker and Connelly (1989) grouped wildlife recreationists into three groups based on motivational

orientations: affiliative-oriented (i.e., social interaction with family/friends), achievement-oriented (i.e., meat or trophy hunting), and appreciative-oriented (i.e., sense of peace or enjoying natural environment).

While factors contributing to satisfaction may vary at different sites (Hammitt et al. 1990), ratings of the reasons for hunting deer in this study further illustrate the importance of considering non-harvest motivations when evaluating hunter satisfaction. All hunter types in this study ranked experiencing nature as the most important reason for hunting deer, while to shoot deer and deer population reduction were the least important reasons. Results from this study suggest Tennessee hunters were generally more appreciative-oriented than achievement-oriented. Appreciative-oriented hunters can be an important cohort in deer management programs. Kellert (1978) suggested nature hunters may have a stronger commitment to deer hunting than utilitarian/meat hunters or dominionistic/sport hunters. Appreciative-oriented hunters, however, are more likely to pass up shots at does when compared to other hunter groups (Decker and Connelly 1989). Encouraging the harvest of antlerless deer by appreciative-oriented (or nature) hunters may help ensure the success of deer management programs requiring increased harvest of antlerless deer.

Important differences in rankings were found within hunter groups. An achievement-oriented reason (to kill a buck with a large rack) received a high ranking for WMA hunters. Differences in determinants of hunter satisfactions and motivations may be a result of location and/or hunting method (Potter et al. 1973, Hayslette et al. 2001). Hunters applying to hunt on WMA's with antler restrictions likely view these areas as better opportunities to harvest larger antlered bucks than their normal hunting areas.

Along with experiencing nature, a place to hunt also received a high rating for club hunters. This is probably related to the fact that club members tended to live in urban areas where access to hunting lands may be limited. Sportsman license holders considered the challenge of the hunt as important as experiencing nature, which suggests those hunters do not necessarily expect to be successful in bagging game.

Study area questions and comparisons

It is important to consider the biological and ecological condition of an area when evaluating the human dimensions data collected from that area. Yuchi WMA hunters had a strong tendency to feel the deer herd at this study area was overpopulated. However, these hunters were more likely to feel adequate nutrition was available to deer at this area when compared to hunters at most of the other study areas. Hunters at this site apparently did not relate the condition of the habitat to the herd densities on this area.

Along with buck quality, Gigliotti (2000) found subjective evaluations of number of bucks and total deer seen had higher correlations with satisfaction than actual harvest success of hunters. Ames Plantation hunters were more likely than hunters from other study areas to report seeing more antlered bucks on this study area than properties managed under traditional deer management guidelines. These hunters also showed a tendency to feel the QDM restrictions at Ames Plantation were working toward their goal. Catoosa WMA hunters were more likely to report seeing fewer antlered bucks and less likely to feel QDM restrictions were working toward their goal when compared to hunters at other study areas.

Relating the harvest data collected from the 2004-05 deer hunting season prior to surveying in spring 2005 gives insight to hunter perceptions at these sites. Because this

was the first hunting season under restrictions to protect bucks younger than 3.5 at Ames Plantation, hunters may have felt restrictions were working at this site due to the lowered harvest of 1.5- and 2.5-year-old bucks. Hunters could learn about management successes through the club newsletter and/or seeing pictures of deer killed on this area at a check-in station. However, no conclusions regarding harvest changes in 3.5-year-old bucks would have been possible at this time because it was the first season under restrictions. Restrictions at Catoosa WMA, however, were in place for six years prior to the 2004-05 season, and harvest data indicated the restrictions implemented in 1998 were working to protect 1.5-year-old bucks and increase the harvest of older bucks. From 1992-1997, the average 1.5- and ≥2.5 year-old buck harvest was 200 and 81, respectively, at Catoosa WMA. Comparatively, average harvest of 1.5-year-old bucks from 1999-2004 was 24, while ≥2.5 year-old bucks harvest was 133. Several factors affect harvest/sightings of bucks (especially older, more elusive ones), including terrain, vegetation, hunting methods, and hunter activity (Hamilton et al. 1995a). There was more open habitat (agricultural fields) and less topography at Ames Plantation than Catoosa WMA, which may have contributed to the higher visibility of bucks on that area. Hunter pressure can also influence deer activity, which would influence buck sightings across areas depending on hunter quotas and characteristics.

Hunters who reported seeing more antlered bucks at a study area when compared to properties managed under traditional deer management guidelines were likely to enjoy their hunting experience more than hunters reporting seeing the same number or fewer antlered bucks on the study area. Buck sightings are likely to be even more important to hunters whose motivations include killing large bucks (i.e., WMA hunters). Regardless of

whether reported buck sightings were a reflection of actual buck numbers, hunter pressure, or varying degrees of visibility, hunters should be informed of management successes (such at Catoosa WMA), especially when poor hunting conditions result in lower numbers of buck observations, which may lower hunter satisfaction.

Another important indicator of hunter satisfaction is the comparison of hunting quality on QDM study areas in relationship to surrounding private lands and whether hunters planned to continue hunting on an area. While sample sizes were small and only descriptive statistics are presented, hunters from study areas that reported more antlered buck sightings and felt QDM restrictions were working toward their goal also reported higher ratings of hunting quality on those study areas when compared to private lands in surrounding counties. Hunters at most areas were apparently satisfied with hunting on the areas because most hunters planned to hunt deer at these areas the following season. Tendencies for hunters at Jasper Mountain and Myers Cove Hunting Clubs to not plan on hunting at these areas the following season was a result of restructuring of lease fees for the Plateau clubs (Mike Black, personal communication).

Management Implications

Hunters surveyed were generally supportive of current regulations and deer management in Tennessee, but there were opportunities for improvement and satisfaction for some groups. Food plots and nutrition were listed as important by several hunters. Managers can increase available nutrition as well as hunter satisfaction by planting food plots. WMA hunters also indicated a need for changes in hunter pressure on WMAs.

Differences between hunter responses and motivations in this study indicate the need for and success of educational efforts pertaining to deer management. While most hunters realized spikes should not be culled in a QDM program, club hunters were less likely to favor this practice. Club hunters were also less likely to favor culling older bucks with poor racks, but at least half of each hunter type was in favor of this practice, even though most would not be able to accurately judge the age of a live buck. Although all hunter types ranked experiencing nature as an important motivation for deer hunting, WMA hunters placed high value in harvesting a large-antlered buck. WMA managers may need to educate hunters about realistic goals in QDM programs to ensure hunter satisfaction. This could be accomplished by holding public meetings and supplying educational material when possible (at check-in stations, in hunting regulations, and on quota permits).

While some hunters expressed realistic expectations for QDM programs, results from this study suggest educational efforts related to QDM and deer biology are needed for all hunter types. Hunters were split on the number of years before QDM objectives should be realized, suggesting the need for clearly defined goals and realistic timetables on QDM areas. Support for the best antler restrictions in a QDM program were probably a result of restrictions used on study areas and suggested a need for educational efforts explaining goals and how age is the real restriction. Antler characteristics should only be used as clues (along with body characteristics) to identify a buck's age. Managers should stress the importance of protecting buck fawns, while implementing an adequate doe harvest.

As land and hunting opportunities are continually lost to development, management and acquisition of lands for hunting opportunities will assume an even greater importance in the future. Club lease rates may prevent membership by certain economic classes of hunters. Green and Stowe (2000) noted privatization and elitism are concerns with QDM programs on private lands because QDM may be associated with higher lease prices (Ditchkoff et al. 1997). Thus, providing opportunities for QDM on public lands allows hunters interested in QDM to avoid financial barriers that may exist in private land QDM programs. The observed hunter preference for areas managed under QDM and success of educational efforts on clubs suggests managers should provide education and opportunities for hunters interested in QDM whenever possible.

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Appendices

Appendix A: Tables

Table 39. Response rates for club hunters, WMA hunters, and sportsman license holders.

Study population	group	# mailed	# eligible[a]	# returned	response rates
Ames Plantation	club	71	71	52	73.2%
Plateau Clubs (JM,MC,RR)	club	163	159	103	64.8%
Oak Ridge	WMA	900	892	492	55.2%
Catoosa	WMA	1000	988	534	54.0%
Yuchi Refuge	WMA	299	297	189	63.6%
sportsman license holders	sportsman	1422	1396	714	51.1%
Overall		3855	3803	2084	54.8%

[a]Some surveys were undeliverable because of incorrect addresses, hunters moving, or deaths.

Table 40. Association between hunter group and sex of respondent.

Are you male or female?		Hunter group[a]			
		club	sportsman	WMA	Total
male	Count	172	664	1178	2014
	% within type	97.2%	97.9%	98.3%	98.1%
	Adjusted Residual	-0.9	-0.4	0.9	
female	Count	5	14	20	39
	% within type	2.8%	2.1%	1.7%	1.9%
	Adjusted Residual	0.9	0.4	-0.9	
Total	Count	177	678	1198	2053
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=1.253, df=2, P=0.534
There were no significant differences between hunter groups.

Table 41. Association between hunter group and highest level of education completed.

Education (Please check the highest level completed.)		Hunter group[a]		
		club	sportsman	WMA
less than high school	Count	1	47	118
	% within type	**0.6%**	7.0%	**9.9%**
	Adjusted Residual	**-3.8**	-1.4	**3.5**
high school graduate or GED	Count	32	223	376
	% within type	**18.4%**	33.0%	31.7%
	Adjusted Residual	**-3.8**	1.4	0.8
technical or vocational school	Count	18	81	167
	% within type	10.3%	12.0%	14.1%
	Adjusted Residual	-1.1	-1.0	1.6
some college	Count	60	165	275
	% within type	**34.5%**	24.4%	23.2%
	Adjusted Residual	**3.2**	-0.1	-1.7
college graduate	Count	49	126	183
	% within type	**28.2%**	18.6%	**15.4%**
	Adjusted Residual	**3.8**	0.9	**-3.0**
post-graduate	Count	14	34	67
	% within type	8.0%	5.0%	5.6%
	Adjusted Residual	1.4	-0.9	0.0
Total	Count	174	676	1186
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=55.402, df=10, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 42. Association between hunter group and area where they lived.

Check the one response that best describes the size of the area where you live.		Hunter group[a]		
		club	sportsman	WMA
a farm	Count	14	150	231
	% within type	**8.0%**	**22.3%**	19.6%
	Adjusted Residual	**-4.0**	**2.2**	0.2
a rural area, but not a farm	Count	62	244	480
	% within type	35.2%	36.3%	**40.8%**
	Adjusted Residual	-1.0	-1.7	**2.2**
a town with less than 10,000 people	Count	18	82	139
	% within type	10.2%	12.2%	11.8%
	Adjusted Residual	-0.7	0.4	0.0
a city 10,000 to under 50,000 people	Count	28	89	154
	% within type	15.9%	13.2%	13.1%
	Adjusted Residual	1.0	-0.1	-0.5
a city 50,000 to under 100,000 people	Count	11	35	75
	% within type	6.3%	5.2%	6.4%
	Adjusted Residual	0.2	-1.0	0.9
a city with 100,000 people or more	Count	43	73	98
	% within type	**24.4%**	10.8%	**8.3%**
	Adjusted Residual	**6.3**	0.3	**-3.9**
Total	Count	176	673	1177
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=57.688, df=10, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 43. Association between hunter group and 2004 household income before taxes.

Check the category that includes your 2004 household income before taxes.		Hunter group[a]		
		club	sportsman	WMA
under $10,000	Count	2	10	21
	% within type	1.3%	1.6%	2.0%
	Adjusted Residual	-0.5	-0.4	0.7
$10,000 to $19,999	Count	0	16	38
	% within type	**.0%**	2.6%	3.5%
	Adjusted Residual	**-2.2**	-0.7	1.9
$20,000 to $29,999	Count	10	53	89
	% within type	6.5%	8.5%	8.3%
	Adjusted Residual	-0.8	0.3	0.2
$30,000 to $39,999	Count	6	72	155
	% within type	**3.9%**	11.5%	**14.4%**
	Adjusted Residual	**-3.4**	-1.0	**2.8**
$40,000 to $49,999	Count	7	89	175
	% within type	**4.6%**	14.2%	**16.3%**
	Adjusted Residual	**-3.7**	-0.4	**2.4**
$50,000 to $74,999	Count	37	192	317
	% within type	24.2%	30.7%	29.5%
	Adjusted Residual	-1.5	0.8	0.1
$75,000 to $99,999	Count	41	101	170
	% within type	**26.8%**	16.1%	15.8%
	Adjusted Residual	**3.4**	-0.6	-1.4
$100,000 and above	Count	50	93	109
	% within type	**32.7%**	14.9%	**10.1%**
	Adjusted Residual	**7.2**	1.1	**-5.1**
Total	Count	153	626	1074
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=95.251, df=14, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 44. Association between hunter group and preference for shooting antlered bucks, does, or fawns.

Do you prefer to shoot antlered bucks, does, or fawns[b]? (please check only one)		Hunter group[a]		
		club	sportsman	WMA
antlered bucks	Count	133	462	885
	% within type	78.2%	**71.9%**	75.8%
	Adjusted Residual	1.1	**-2.1**	1.3
does	Count	8	62	63
	% within type	4.7%	**9.6%**	**5.4%**
	Adjusted Residual	-1.1	**3.6**	**-2.8**
no preference	Count	29	119	219
	% within type	17.1%	18.5%	18.8%
	Adjusted Residual	-0.5	0.0	0.3
Total	Count	170	643	1167
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=13.653, df=4, *P*=0.008
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.
[b]Fawns excluded from analysis due to low frequency (*n*=1).

Table 45. Association between hunter group and whether a "quality" buck and a "trophy" buck are the same thing.

In your opinion, is a “quality” buck and a “trophy” buck the same thing?		Hunter group[a]			
		club	sportsman	WMA	Total
yes	Count	50	178	339	567
	% within type	28.4%	26.3%	28.4%	27.7%
	Adjusted Residual	0.2	-1.0	0.8	
no	Count	126	498	856	1480
	% within type	71.6%	73.7%	71.6%	72.3%
	Adjusted Residual	-0.2	1.0	-0.8	
Total	Count	176	676	1195	2047
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=0.943, df=2, *P*=0.624
There were no significant differences between hunter groups

Table 46. Association between hunter group and how many antlered bucks should be allowed per individual in the Tennessee state bag limit.

How many antlered bucks should be allowed per individual in the Tennessee state bag limit?		Hunter group[a]		
		club	sportsman	WMA
1	Count	17	102	204
	% within type	**10.4%**	16.8%	18.6%
	Adjusted Residual	**-2.5**	-0.4	1.8
2	Count	91	224	381
	% within type	**55.5%**	36.9%	**34.7%**
	Adjusted Residual	**5.1**	-0.2	**-2.7**
3	Count	40	160	367
	% within type	24.4%	**26.4%**	**33.5%**
	Adjusted Residual	-1.7	**-2.6**	**3.5**
≥4	Count	16	121	145
	% within type	**9.8%**	**19.9%**	**13.2%**
	Adjusted Residual	**-2.0**	**4.1**	**-2.7**
Total	Count	164	607	1097
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=45.902, df=6, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 47. Association between hunter group and whether antler restrictions should be implemented statewide in Tennessee.

Should antler restrictions be implemented statewide in Tennessee?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	123	385	638
	% within type	**72.8%**	64.1%	**57.7%**
	Adjusted Residual	**3.3**	1.8	**-3.6**
no	Count	46	216	467
	% within type	**27.2%**	35.9%	**42.3%**
	Adjusted Residual	**-3.3**	-1.8	**3.6**
Total	Count	169	601	1105
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=17.177, df=2, $P<0.001$
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 48. Association between hunter group and whether genetics is a "problem" for the deer herd on many properties in Tennessee.

Is genetics a "problem" for the deer herd on many properties in Tennessee?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	33	286	458
	% within type	**25.8%**	**55.6%**	51.9%
	Adjusted Residual	**-6.0**	**2.6**	0.8
no	Count	95	228	425
	% within type	**74.2%**	**44.4%**	48.1%
	Adjusted Residual	**6.0**	**-2.6**	-0.8
Total	Count	128	514	883
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=37.271, df=2, $P<0.001$
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 49. Association between hunter group and whether the deer herd across most of Tennessee is overpopulated.

Is the deer herd across most of Tennessee overpopulated?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	72	296	357
	% within type	49.0%	**51.8%**	**35.1%**
	Adjusted Residual	1.9	**6.0**	**-6.7**
no	Count	75	275	661
	% within type	51.0%	**48.2%**	**64.9%**
	Adjusted Residual	-1.9	**-6.0**	**6.7**
Total	Count	147	571	1018
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=45.739, df=2, $P<0.001$
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 50. Association between hunter group and whether the age structure of the deer herd over most of Tennessee is balanced.

Is the age structure of the deer herd over most of Tennessee balanced?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	12	153	253
	% within type	**10.7%**	34.8%	32.9%
	Adjusted Residual	**-5.0**	1.7	1.2
no	Count	100	287	515
	% within type	**89.3%**	65.2%	67.1%
	Adjusted Residual	**5.0**	-1.7	-1.2
Total	Count	112	440	768
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=25.262, df=2, $P<0.001$
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 51. Association between hunter group and whether adequate nutrition is available to deer over most of Tennessee.

Is adequate nutrition available to deer over most of Tennessee?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	99	393	613
	% within type	71.7%	**68.6%**	**60.8%**
	Adjusted Residual	1.9	**2.6**	**-3.6**
no	Count	39	180	395
	% within type	28.3%	**31.4%**	**39.2%**
	Adjusted Residual	-1.9	**-2.6**	**3.6**
Total	Count	138	573	1008
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=13.248, df=2, P=0.001

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 52. Association between hunter group and what they think influences deer weight most in Tennessee.

What influences deer weight most in Tennessee?		Hunter group[a]		
		club	sportsman	WMA
available food resources	Count	94	436	828
	% within type	**54.3%**	68.0%	**71.7%**
	Adjusted Residual	**-4.4**	-0.6	**3.1**
herd management	Count	63	165	262
	% within type	**36.4%**	25.7%	**22.7%**
	Adjusted Residual	**3.7**	0.6	**-2.7**
soils	Count	16	40	65
	% within type	9.2%	6.2%	5.6%
	Adjusted Residual	1.8	0.1	-1.1
Total	Count	173	641	1155
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=21.599, df=4, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 53. Association between hunter group and satisfaction levels with TWRA's statewide deer management strategy.

How satisfied are you with TWRA's statewide deer management strategy?		Hunter group[a]			
		club	sportsman	WMA	Total
very dissatisfied	Count	16	66	114	196
	% within type	9.1%	9.9%	9.5%	9.6%
	Adjusted Residual	-0.2	0.3	-0.1	
somewhat dissatisfied	Count	43	130	242	415
	% within type	24.4%	19.4%	20.2%	20.3%
	Adjusted Residual	1.4	-0.7	-0.2	
neither dissatisfied nor satisfied	Count	21	112	182	315
	% within type	11.9%	16.7%	15.2%	15.4%
	Adjusted Residual	-1.3	1.2	-0.3	
somewhat satisfied	Count	88	290	544	922
	% within type	50.0%	43.3%	45.4%	45.1%
	Adjusted Residual	1.4	-1.1	0.3	
very satisfied	Count	8	71	116	195
	% within type	4.5%	10.6%	9.7%	9.5%
	Adjusted Residual	-2.4	1.1	0.3	
Total	Count	176	669	1198	2043
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=10.874, df=8, *P*=0.209
There were no significant differences between hunter groups

Table 54. Association between hunter group and whether they hunted white-tailed deer in states other than Tennessee during the 2004-05 season.

Did you hunt white-tailed deer in states other than Tennessee during the 2004-05 season?		Hunter group[a]			
		club	sportsman	WMA	Total
yes	Count	54	155	276	485
	% within type	30.3%	23.0%	23.0%	23.6%
	Adjusted Residual	2.2	-0.5	-0.8	
no	Count	124	519	926	1569
	% within type	69.7%	77.0%	77.0%	76.4%
	Adjusted Residual	-2.2	0.5	0.8	
Total	Count	178	674	1202	2054
	% within type2	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=4.886, df=2, P=0.087
There were no significant differences between hunter groups

Table 55. States where survey respondents hunted white-tailed deer during 2004-05.

Please list states (other than TN) where you hunted white-tailed deer during the 2004-05 season.	n	Percent of categorized responses[a]
KENTUCKY	128	19.7%
OHIO	74	11.4%
ILLINOIS	73	11.2%
ALABAMA	67	10.3%
VIRGINIA	45	6.9%
GEORGIA	41	6.3%
MISSISSIPPI	27	4.1%
SOUTH CAROLINA	26	4.0%
TEXAS	21	3.2%
MISSOURI	16	2.5%
NORTH CAROLINA	16	2.5%
INDIANA	15	2.3%
MICHIGAN	13	2.0%
KANSAS	12	1.8%
WEST VIRGINIA	12	1.8%
PENNSYLVANIA	12	1.8%
IOWA	8	1.2%
ARKANSAS	8	1.2%
NEBRASKA	6	0.9%
WYOMING	4	0.6%
WISCONSIN	4	0.6%
IDAHO	4	0.6%
FLORIDA	3	0.5%
COLORADO	3	0.5%
ARIZONA	2	0.3%
MONTANA	2	0.3%
SOUTH DAKOTA	2	0.3%
OKLAHOMA	2	0.3%
UTAH	1	0.2%
MAINE	1	0.2%
MARYLAND	1	0.2%
MINNESOTA	1	0.2%
NEW YORK	1	0.2%

[a]Open-ended question requiring hunters to list responses

Table 56. Reasons listed by respondents for hunting white-tailed deer in states other than TN during 2004-05.

Please tell why you hunted in other states during the 2004-05 season.	n	Percent of categorized responses[a]
BIG TROPHY DEER	173	56.0%
FAMILY AND FRIENDS	48	15.5%
DEER HEALTH AND QUALITY	31	10.0%
HIGHER POPULATION	25	8.1%
PRIVATE LAND	16	5.2%
NEAR STATE LINE	7	2.3%
LONGER SEASON	5	1.6%
MORE PUBLIC LAND	4	1.3%

[a]Open-ended question requiring hunters to list responses

Table 57. Association between hunter group and how they rated their knowledge of Quality Deer Management.

How would you rate your knowledge of Quality Deer Management?		Hunter group[a]		
		club	sportsman	WMA
not at all knowledgeable	Count	4	90	131
	% within type	**2.3%**	**13.3%**	11.0%
	Adjusted Residual	**-3.9**	**2.3**	0.0
somewhat knowledgeable	Count	142	507	910
	% within type	80.7%	74.7%	76.2%
	Adjusted Residual	1.5	-1.1	0.2
very knowledgeable	Count	30	82	153
	% within type	17.0%	12.1%	12.8%
	Adjusted Residual	1.7	-0.8	-0.2
Total	Count	176	679	1194
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=18.722, df=4, *P*=0.001
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 58. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether Quality Deer Management (QDM) is a sensible management philosophy.

Where possible, do you think Quality Deer Management (QDM) is a sensible management philosophy?		Hunter group[a]			
		club	sportsman	WMA	Total
yes	Count	164	511	895	1570
	% within type	98.2%	96.1%	95.3%	95.8%
	Adjusted Residual	1.6	0.3	-1.3	
no	Count	3	21	44	68
	% within type	1.8%	3.9%	4.7%	4.2%
	Adjusted Residual	-1.6	-0.3	1.3	
Total	Count	167	532	939	1638
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=3.057, df=2, P=0.217
There were no significant differences between hunter groups

Table 59. Association between hunter group (those hunters at least somewhat knowledgeable with QDM**)** and how many years they think it should take before QDM objectives are realized.

Upon initiating a QDM program, how many years do you think it should take before QDM objectives are realized?		Hunter group[a]			
		club	sportsman	WMA	Total
≤ 3 years	Count	41	199	342	582
	% within type	23.7%	35.2%	32.7%	32.6%
	Adjusted Residual	-2.6	1.6	0.1	
4 years	Count	40	99	181	320
	% within type	23.1%	17.5%	17.3%	17.9%
	Adjusted Residual	1.9	-0.3	-0.8	
5 years	Count	62	181	338	581
	% within type	35.8%	32.0%	32.3%	32.5%
	Adjusted Residual	1.0	-0.3	-0.3	
≥ 6 years	Count	30	87	186	303
	% within type	17.3%	15.4%	17.8%	17.0%
	Adjusted Residual	0.1	-1.2	1.1	
Total	Count	173	566	1047	1786
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=10.160, df=6, *P*=0.118
There were no significant differences between hunter groups

Table 60. List of most important objectives in a QDM program.

What do you consider to be the most important objectives in a QDM program?	n	Percent of categorized responses[a]
BUCK DOE RATIO	466	18.7%
HERD QUALITY AND HEALTH	409	16.4%
BUCKS	390	15.6%
FOOD	375	15.0%
AGE STRUCTURE	318	12.7%
HERD CONTROL	270	10.8%
ANTLER RESTRICTIONS	173	6.9%
GENETICS	57	2.3%
HUNTING EXPERIENCE	22	0.9%
STOP POACHING	15	0.6%

[a]Open-ended question requiring hunters to list responses

Table 61. List of primary benefits of a QDM program.

What is the primary benefit of a QDM program?	n	Percent of categorized responses[a]
HEALTHIER HERD	653	38.0%
BUCKS	628	36.5%
OLDER/MATURE DEER	154	9.0%
BALANCE SEX RATIO	91	5.3%
BIGGER DEER	86	5.0%
QUALITY HUNTING EXPERIENCE	63	3.7%
GENETICS	22	1.3%
HERD SIZE	14	0.8%
IMPROVE HABITAT	8	0.5%

[a]Open-ended question requiring hunters to list responses

Table 62. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and how old they think a buck should be before it is "legal" to harvest in a QDM program.

How old do you think a buck should be before it is "legal" to harvest in a QDM program?		Hunter group[a]		
		club	sportsman	WMA
2 ½ years	Count	35	134	274
	% within type	20.3%	23.9%	26.6%
	Adjusted Residual	-1.5	-0.8	1.7
3 ½ years	Count	118	309	579
	% within type	**68.6%**	55.1%	56.3%
	Adjusted Residual	**3.2**	-1.2	-0.8
4 ½ years	Count	17	107	150
	% within type	**9.9%**	**19.1%**	14.6%
	Adjusted Residual	**-2.2**	**2.8**	-1.3
> 4 ½ years	Count	2	11	26
	% within type	1.2%	2.0%	2.5%
	Adjusted Residual	-1.0	-0.5	1.1
Total	Count	172	561	1029
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=17.471, df=6, *P*=0.008
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 63. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and what they think is the best antler restriction in a QDM program.

What do you think is the best antler restriction in a QDM program?		Hunter group[a]		
		club	sportsman	WMA
antler point	Count	19	242	552
	% within type	**11.4%**	49.5%	**58.7%**
	Adjusted Residual	**-10.8**	-0.8	**7.4**
spread	Count	4	32	53
	% within type	2.4%	6.5%	5.6%
	Adjusted Residual	-1.9	1.1	0.1
main beam length	Count	0	4	10
	% within type	.0%	.8%	1.1%
	Adjusted Residual	-1.3	-0.2	1.0
gross score	Count	109	13	11
	% within type	**65.7%**	**2.7%**	**1.2%**
	Adjusted Residual	**28.2**	**-5.5**	**-12.4**
depends on average characteristics of bucks in that area	Count	31	117	158
	% within type	18.7%	**23.9%**	**16.8%**
	Adjusted Residual	-0.2	**3.2**	**-2.9**
no antler restriction, but impose a 1-buck limit	Count	3	81	156
	% within type	**1.8%**	16.6%	**16.6%**
	Adjusted Residual	**-5.0**	1.1	**2.1**
Total	Count	166	489	940
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=828.952, df=10, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Circumference excluded from analysis due to low frequency (n=2).

Table 64. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and what they think is the most important factor in the success of a QDM program.

Which is the most important factor in the success of a QDM program?		Hunter group[a]		
		club	sportsman	WMA
age	Count	106	210	369
	% within type	**61.6%**	37.2%	**35.7%**
	Adjusted Residual	**6.5**	-0.9	**-3.1**
nutrition	Count	39	184	364
	% within type	**22.7%**	32.6%	**35.2%**
	Adjusted Residual	**-3.1**	-0.3	**2.2**
genetics	Count	27	170	300
	% within type	**15.7%**	30.1%	29.0%
	Adjusted Residual	**-3.8**	1.3	1.0
Total	Count	172	564	1033
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=43.701, df=4, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 65. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether they expect deer, on average, to weigh more on properties managed under QDM guidelines.

Do you expect deer, on average, to weigh more on properties managed under QDM guidelines?		Hunter group[a]			
		club	sportsman	WMA	Total
yes	Count	129	470	841	1440
	% within type	80.6%	87.9%	86.1%	86.1%
	Adjusted Residual	-2.1	1.4	-0.1	
no	Count	31	65	136	232
	% within type	19.4%	12.1%	13.9%	13.9%
	Adjusted Residual	2.1	-1.4	0.1	
Total	Count	160	535	977	1672
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=5.385 df=2, P=0.068
There were no significant differences between hunter groups

Table 66. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether they prefer to hunt areas under QDM restrictions.

Do you prefer to hunt areas under QDM restrictions?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	144	352	706
	% within type	**90.6%**	76.4%	77.3%
	Adjusted Residual	**3.9**	-1.3	-1.2
no	Count	15	109	207
	% within type	**9.4%**	23.6%	22.7%
	Adjusted Residual	**-3.9**	1.3	1.2
Total	Count	159	461	913
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=15.659, df=2, P<0.001
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 67. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether spikes should be killed intentionally (i.e., culled) in a QDM program.

Should spikes be killed intentionally (i.e., culled) in a QDM program?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	9	108	225
	% within type	**5.8%**	22.9%	**23.2%**
	Adjusted Residual	**-5.0**	0.9	**2.2**
no	Count	146	364	743
	% within type	**94.2%**	77.1%	**76.8%**
	Adjusted Residual	**5.0**	-0.9	**-2.2**
Total	Count	155	472	968
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=24.942, df=2, $P<0.001$
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 68. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether older bucks with poor racks should be culled in a QDM program.

Should older bucks with poor racks be culled in a QDM program?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	69	422	649
	% within type	**49.3%**	**83.1%**	**68.8%**
	Adjusted Residual	**-6.1**	**6.9**	**-3.0**
no	Count	71	86	294
	% within type	**50.7%**	**16.9%**	**31.2%**
	Adjusted Residual	**6.1**	**-6.9**	**3.0**
Total	Count	140	508	943
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=70.808, df=2, $P<0.001$
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 69. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether does should be included in the harvest in a QDM program.

Should does be included in the harvest in a QDM program?		Hunter group[a]			
		club	sportsman	WMA	Total
yes	Count	159	552	1033	1744
	% within type	95.2%	96.0%	93.3%	94.3%
	Adjusted Residual	0.5	2.1	-2.3	
no	Count	8	23	74	105
	% within type	4.8%	4.0%	6.7%	5.7%
	Adjusted Residual	-0.5	-2.1	2.3	
Total	Count	167	575	1107	1849
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=5.363, df=2, P=0.068
There were no significant differences between hunter groups

Table 70. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether buck fawns should be "legal for harvest" in a QDM program.

Should buck fawns be "legal for harvest" in a QDM program?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	9	48	145
	% within type	**5.2%**	**8.6%**	**13.1%**
	Adjusted Residual	**-2.6**	**-2.1**	**3.5**
no	Count	164	508	965
	% within type	**94.8%**	**91.4%**	**86.9%**
	Adjusted Residual	**2.6**	**2.1**	**-3.5**
Total	Count	173	556	1110
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=13.964, df=2, P=0.001
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 71. Association between hunter group (those hunters at least somewhat knowledgeable with QDM) and whether doe fawns should be "legal for harvest" in a QDM program.

Should doe fawns be "legal for harvest" in a QDM program?		Hunter group[a]		
		club	sportsman	WMA
yes	Count	84	171	294
	% within type	**50.0%**	31.3%	**26.9%**
	Adjusted Residual	**5.8**	0.5	**-3.9**
no	Count	84	376	797
	% within type	**50.0%**	68.7%	**73.1%**
	Adjusted Residual	**-5.8**	-0.5	**3.9**
Total	Count	168	547	1091
	% within type	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=36.841, df=2, P<0.001
Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Table 72. Reasons for hunting deer by hunter groups.

	club			sportsman			WMA		
	mean[a]		rank	mean[a]		rank	mean[a]		rank
Experience nature	4.170	a	1	4.336	a	1	3.795	a	1
A place to hunt (club and WMA only)	3.909	ab	2	-	-	-	3.263	cd	5
Challenge of the hunt	3.806	bc	3	4.219	a	2	3.565	b	3
Solitude	3.673	bc	4	3.637	bc	4	3.026	e	7
To kill a buck with a large rack	3.539	bc	5	3.518	c	6	3.779	a	2
Social interaction	3.479	c	6	3.807	b	3	3.330	c	4
To see lots of deer	3.061	d	7	3.584	c	5	3.171	de	6
To get venison for food	2.588	e	8	3.458	c	7	2.804	f	8
To shoot deer	2.182	f	9	2.180	e	9	2.345	g	9
Deer population reduction	1.994	f	10	2.775	d	8	2.056	h	10

[a]Scale: 1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = very important, 5 = extremely important. Within a group, means are similar if followed by the same letter.

Table 73. Association between hunter group and whether they hunted deer on any Wildlife Management Areas (WMAs) during the 2004-05 season.

Did you hunt deer on any Wildlife Management Areas (WMAs) during the 2004-05 season?		Hunter group[a]			
		club	sportsman	WMA	Total
yes	Count	60	283	443	786
	% within type	34.1%	41.8%	37.7%	38.8%
	Adjusted Residual	-1.3	2.0	-1.1	
no	Count	116	394	732	1242
	% within type	65.9%	58.2%	62.3%	61.2%
	Adjusted Residual	1.3	-2.0	1.1	
Total	Count	176	677	1175	2028
	% within type	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=4.810, df=2, P=0.090
There were no significant differences between hunter groups

Table 74. Ways to improve deer hunting on Catoosa WMA listed by hunters drawn for quota hunts on Catoosa WMA during the 2004-05 season.

What could TWRA do (or change) to improve deer hunting on Catoosa WMA?	n	Percent of categorized responses[a]
FOOD PLOTS	84	15.7%
KILL MORE DOES	33	6.2%
LOWER HUNTER PRESSURE	29	5.4%
MORE HUNTS	13	2.4%
STOP POACHING	6	1.1%
BETTER ACCESS	3	0.6%
START QDM	2	0.4%
BUCK DOE RATIO	2	0.4%
GOOD JOB	1	0.2%
RELEASE DEER	1	0.2%
MORE SCOUTING	0	0.0%

[a]Open-ended question requiring hunters to list responses (that is, there were no options listed on the survey)

Table 75. Ways to improve deer hunting on Oak Ridge WMA listed by hunters drawn for quota hunts on Oak Ridge WMA during the 2004-05 season.

What could TWRA do (or change) to improve deer hunting on Oak Ridge WMA?	n	Percent of categorized responses[a]
FOOD PLOTS	66	13.4%
MORE HUNTS	31	6.3%
BETTER ACCESS	23	4.7%
LOWER HUNTER PRESSURE	20	4.1%
MORE SCOUTING	14	2.8%
KILL MORE DOES	14	2.8%
BUCK DOE RATIO	3	0.6%
GOOD JOB	1	0.2%
RELEASE DEER	1	0.2%
START QDM	0	0.0%
STOP POACHING	0	0.0%

[a]Open-ended question requiring hunters to list responses

Table 76. Ways to improve deer hunting on Yuchi WMA listed by hunters drawn for quota hunts on Yuchi WMA during the 2004-05 season.

What could TWRA do (or change) to improve deer hunting on Yuchi WMA?	n	Percent of categorized responses[a]
FOOD PLOTS	11	5.8%
KILL MORE DOES	11	5.8%
MORE HUNTS	11	5.8%
LOWER HUNTER PRESSURE	5	2.6%
GOOD JOB	3	1.6%
BETTER ACCESS	2	1.1%
BUCK DOE RATIO	2	1.1%
START QDM	1	0.5%
STOP POACHING	0	0.0%
MORE SCOUTING	0	0.0%
RELEASE DEER	0	0.0%

[a]Open-ended question requiring hunters to list responses

Table 77. Association between individual study areas and the numbers of bucks seen by hunters on these areas when compared to properties managed under traditional deer management guidelines.

Do you see fewer, the same, or more antlered bucks at study area than on properties managed under traditional deer management guidelines?		Study Area[a]						
		AP	CA	JM	MC	OR	RR	YU
fewer	Count	1	166	9	5	99	16	33
	% within area	**2.3%**	**39.4%**	22.0%	50.0%	**25.6%**	34.8%	**21.2%**
	Adjusted Residual	**-4.0**	**5.5**	-1.1	1.4	**-2.3**	0.8	**-2.5**
same	Count	8	113	11	3	130	10	32
	% within area	18.6%	26.8%	26.8%	30.0%	**33.6%**	21.7%	**20.5%**
	Adjusted Residual	-1.4	-0.6	-0.1	0.2	**3.2**	-0.9	**-2.2**
more	Count	34	142	21	2	158	20	91
	% within area	**79.1%**	**33.7%**	51.2%	20.0%	40.8%	43.5%	**58.3%**
	Adjusted Residual	**5.0**	**-4.6**	1.2	-1.4	-0.8	0.2	**4.3**
Total	Count	43	421	41	10	387	46	156
	% within area	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=75.173, df=12, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.
Coding for study areas: AP=Ames Plantation, CA=Catoosa WMA, JM=Jasper Mountain, MC=Myers Cove, OR=Oak Ridge WMA, RR=Rocky River, YU=Yuchi Refuge

Table 78. Association between individual study areas and whether the QDM restrictions at the study area are working toward their goal.

Are the QDM restrictions at study area working toward their goal?		Study Area[a]						
		AP	CA	JM	MC	OR	RR	YU
yes	Count	39	263	40	3	222	43	95
	% within area	**100.0%**	**83.8%**	85.1%	60.0%	87.4%	95.6%	88.8%
	Adjusted Residual	**2.5**	**-2.1**	-0.4	-1.8	0.3	1.8	0.6
no	Count	0	51	7	2	32	2	12
	% within area	**.0%**	**16.2%**	14.9%	40.0%	12.6%	4.4%	11.2%
	Adjusted Residual	**-2.5**	**2.1**	0.4	1.8	-0.3	-1.8	-0.6
Total	Count	39	314	47	5	254	45	107
	% within area	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=15.294, df=6, *P*=0.018

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.

Coding for study areas: AP=Ames Plantation, CA=Catoosa WMA, JM=Jasper Mountain, MC=Myers Cove, OR=Oak Ridge WMA, RR=Rocky River, YU=Yuchi Refuge

Table 79. Association between individual study areas and whether the deer herd at each respective study area is overpopulated.

Is the deer herd at study area overpopulated?		Study Area[a]						
		AP	CA	JM	MC	OR	RR	YU
yes	Count	6	42	4	0	65	1	65
	% within area	15.0%	**9.9%**	9.5%	.0%	17.4%	**2.0%**	**45.1%**
	Adjusted Residual	-0.3	**-4.9**	-1.3	-1.4	0.3	**-2.9**	**9.7**
no	Count	34	383	38	10	308	49	79
	% within area	85.0%	**90.1%**	90.5%	100.0%	82.6%	**98.0%**	**54.9%**
	Adjusted Residual	0.3	**4.9**	1.3	1.4	-0.3	**2.9**	**-9.7**
Total	Count	40	425	42	10	373	50	144
	% within area	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=108.502, df=6, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.
Coding for study areas: AP=Ames Plantation, CA=Catoosa WMA, JM=Jasper Mountain, MC=Myers Cove, OR=Oak Ridge WMA, RR=Rocky River, YU=Yuchi Refuge

Table 80. Association between individual study areas and whether adequate nutrition is available to deer at the study area.

Is adequate nutrition available to deer at study area?		Study Area[a]						
		AP	CA	JM	MC	OR	RR	YU
yes	Count	47	243	26	9	222	27	154
	% within area	**97.9%**	**57.6%**	56.5%	75.0%	64.5%	60.0%	**90.6%**
	Adjusted Residual	**4.7**	**-5.2**	-1.5	.6	-1.2	-1.0	**7.1**
no	Count	1	179	20	3	122	18	16
	% within area	**2.1%**	**42.4%**	43.5%	25.0%	35.5%	40.0%	**9.4%**
	Adjusted Residual	**-4.7**	**5.2**	1.5	-.6	1.2	1.0	**-7.1**
Total	Count	48	422	46	12	344	45	170
	% within area	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=84.997, df=6, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.
Coding for study areas: AP=Ames Plantation, CA=Catoosa WMA, JM=Jasper Mountain, MC=Myers Cove, OR=Oak Ridge WMA, RR=Rocky River, YU=Yuchi Refuge

Table 81. Association between individual study areas and whether hunters plan to hunt deer at each study area next hunting season.

Do you plan on hunting deer at study area next hunting season?		Study Area[a]						
		AP	CA	JM	MC	OR	RR	YU
yes	Count	49	410	35	1	401	40	165
	% within area	94.2%	89.1%	**70.0%**	**10.0%**	89.7%	83.3%	**94.8%**
	Adjusted Residual	1.3	0.4	**-4.3**	**-7.9**	0.8	-1.2	**2.7**
no	Count	3	50	15	9	46	8	9
	% within area	5.8%	10.9%	**30.0%**	**90.0%**	10.3%	16.7%	**5.2%**
	Adjusted Residual	-1.3	-0.4	**4.3**	**7.9**	-0.8	1.2	**-2.7**
Total	Count	52	460	50	10	447	48	174
	% within area	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=89.391, df=6, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.
Coding for study areas: AP=Ames Plantation, CA=Catoosa WMA, JM=Jasper Mountain, MC=Myers Cove, OR=Oak Ridge WMA, RR=Rocky River, YU=Yuchi Refuge

Table 82. Association between hunters and whether they hunted public areas (other than study areas) during the 2004-05 season.

Did you hunt public areas (other than study area) during the 2004-05 season?		Study Area[a]/Sportsman license holder							
		AP	CA	JM	MC	OR	random	RR	YU
yes	Count	9	240	26	8	235	328	23	94
	% within area	**17.3%**	47.2%	45.6%	61.5%	52.2%	49.8%	42.6%	52.8%
	Adjusted Residual	**-4.6**	-0.9	-0.5	0.9	1.6	0.6	-0.9	1.1
no	Count	43	269	31	5	215	330	31	84
	% within area	**82.7%**	52.8%	54.4%	38.5%	47.8%	50.2%	57.4%	47.2%
	Adjusted Residual	**4.6**	0.9	0.5	-0.9	-1.6	-0.6	0.9	-1.1
Total	Count	52	509	57	13	450	658	54	178
	% within area	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=26.642, df=7, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.
Coding for study areas: AP=Ames Plantation, CA=Catoosa WMA, JM=Jasper Mountain, MC=Myers Cove, OR=Oak Ridge WMA, random=sportsman license holders, RR=Rocky River, YU=Yuchi Refuge

Table 83. Association between hunters and whether they hunted private land during the 2004-05 season.

Did you hunt private land during the 2004-05 season?		Study Area[a]/Sportsman license holder							
		AP	CA	JM	MC	OR	random	RR	YU
yes	Count	27	441	29	11	422	606	27	162
	% within area	**51.9%**	85.0%	**50.9%**	84.6%	87.4%	**91.0%**	**50.0%**	89.5%
	Adjusted Residual	**-6.8**	-0.2	**-7.4**	-0.1	1.5	**5.1**	**-7.4**	1.7
no	Count	25	78	28	2	61	60	27	19
	% within area	**48.1%**	15.0%	**49.1%**	15.4%	12.6%	**9.0%**	**50.0%**	10.5%
	Adjusted Residual	**6.8**	0.2	**7.4**	0.1	-1.5	**-5.1**	**7.4**	-1.7
Total	Count	52	519	57	13	483	666	54	181
	% within area	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

[a]Pearson Chi-Square=174.035, df=7, $P<0.001$

Percentages and adjusted residuals in bold indicate tendencies between groups, based on an adjusted residual of at least +/- 2.0.
Coding for study areas: AP=Ames Plantation, CA=Catoosa WMA, JM=Jasper Mountain, MC=Myers Cove, OR=Oak Ridge WMA, random=sportsman license holders, RR=Rocky River, YU=Yuchi Refuge

Table 84. Ratings[a] of public areas and private lands hunted by Ames Plantation hunters during the 2004-05 season.

Public Areas Hunted[b]	n	rating	Private Lands Hunted	n	rating
118-LAND BETWEEN THE LAKES	2	2.5	MAURY	1	3.0
135-WOLF RIVER	2	1.5	WILLIAMSON	1	3.0
117-JOHN TULLY	1	1.0	HENDERSON	1	2.0
121-MEEMAN-SHELBY FOREST	1	1.0	FAYETTE	10	1.8
216-LAUREL HILL	5	1.0	SHELBY	4	1.8
CHICKASAW NWR	1	1.0	HARDEMAN	8	1.6
LOWER HATCHIE NWR	1	1.0	MADISON	2	1.5
			MCNAIRY	2	1.5
			CHESTER	1	1.0
			CLAY	1	1.0
			LAUDERDALE	2	1.0
			LAWRENCE	1	1.0
			TIPTON	4	1.0

[a]Hunters were asked to list the public areas and private lands they hunted during the 2004-05 season and then rank them in relation to deer hunting on Ames Plantation according to the following scale:
1=worse than Ames Plantation, 2=about the same as Ames Plantation, 3=better than Ames Plantation
[b]Numbers listed beside public areas correspond to coding in the 2004 Tennessee Hunting and Trapping Guide

Table 85. Ratings[a] of public areas and private lands hunted by Jasper Mountain hunters during the 2004-05 season.

Public Areas Hunted[b]	n	rating	Private Lands Hunted	n	rating
303-CATOOSA	1	3.0	HARDIN	1	3.0
VOLUNTEER AAP	1	3.0	HICKMAN	1	3.0
118-LAND BETWEEN THE LAKES	5	2.8	LINCOLN	2	3.0
UNKNOWN	4	2.3	MADISON	1	3.0
308-FALL CREEK FALLS	3	2.0	RHEA	2	2.5
320-PRENTICE COOPER	7	1.6	SEQUATCHIE	2	2.5
201-AEDC AND WOODS RESERVOIR	2	1.5	FRANKLIN	11	2.4
216-LAUREL HILL	1	1.0	HAMILTON	4	2.3
402-CHEROKEE	2	1.0	MARION	11	2.1
			BLEDSOE	1	2.0
			HENRY	1	2.0
			MCMINN	1	2.0
			MORGAN	1	2.0
			VAN BUREN	1	2.0
			WARREN	1	2.0
			MEIGS	2	1.5
			BRADLEY	2	1.0

[a]Hunters were asked to list the public areas and private lands they hunted during the 2004-05 season and then rank them in relation to deer hunting on Jasper Mountain according to the following scale:
1=worse than Jasper Mountain, 2=about the same as Jasper Mountain, 3=better than Jasper Mountain
[b]Numbers listed beside public areas correspond to coding in the 2004 Tennessee Hunting and Trapping Guide

Table 86. Ratings[a] of public areas and private lands hunted by Myers Cove hunters during the 2004-05 season.

Public Areas Hunted[b]	n	rating	Private Lands Hunted	n	rating
210-FLINTVILLE HATCHERY	2	3.0	FRANKLIN	1	3.0
303-CATOOSA	1	3.0	GILES	1	3.0
UNKNOWN	1	3.0	HICKMAN	1	3.0
VOLUNTEER AAP	1	3.0	LINCOLN	1	3.0
118-LAND BETWEEN THE LAKES	1	2.0	MADISON	1	3.0
201-AEDC AND WOODS RESERVOIR	2	2.0	RHEA	1	3.0
323-YUCHI REFUGE	1	2.0	RUTHERFORD	1	3.0
320-PRENTICE COOPER	1	1.0	WARREN	1	3.0
402-CHEROKEE	1	1.0	SEQUATCHIE	5	2.8
			MARION	2	2.5
			MEIGS	1	2.0
			VAN BUREN	1	2.0
			WILLIAMSON	1	2.0
			HAMILTON	2	1.5

[a]Hunters were asked to list the public areas and private lands they hunted during the 2004-05 season and then rank them in relation to deer hunting on Myers Cove according to the following scale:
1=worse than Myers Cove, 2=about the same as Myers Cove, 3=better than Myers Cove
[b]Numbers listed beside public areas correspond to coding in the 2004 Tennessee Hunting and Trapping Guide

Table 87. Ratings[a] of public areas and private lands hunted by Rocky River hunters during the 2004-05 season.

Public Areas Hunted[b]	n	rating	Private Lands Hunted	n	rating
308-FALL CREEK FALLS	1	3.0	FRANKLIN	1	3.0
VOLUNTEER AAP	1	3.0	GRUNDY	1	3.0
323-YUCHI REFUGE	3	2.3	HICKMAN	1	3.0
316-OAK RIDGE	1	2.0	MADISON	1	3.0
201-AEDC AND WOODS RESERVOIR	6	1.8	MCMINN	1	3.0
118-LAND BETWEEN THE LAKES	4	1.8	MCNAIRY	1	3.0
320-PRENTICE COOPER	5	1.6	RHEA	1	3.0
216-LAUREL HILL	2	1.0	RUTHERFORD	1	3.0
303-CATOOSA	1	1.0	WILSON	1	3.0
402-CHEROKEE	2	1.0	WARREN	3	2.7
			MARION	4	2.3
			MEIGS	4	2.3
			SEQUATCHIE	11	2.2
			BLEDSOE	1	2.0
			HAMILTON	3	2.0
			WHITE	1	2.0
			BRADLEY	2	1.0

[a]Hunters were asked to list the public areas and private lands they hunted during the 2004-05 season and then rank them in relation to deer hunting on Rocky River according to the following scale:
1=worse than Rocky River, 2=about the same as Rocky River, 3=better than Rocky River
[b]Numbers listed beside public areas correspond to coding in the 2004 Tennessee Hunting and Trapping Guide

Table 88. Ratings[a] of public areas hunted (at least 5 hunters reporting) by Oak Ridge WMA hunters during the 2004-05 season.

Public Areas Hunted[b]	n	rating
FORT CAMPBELL	24	2.7
HOLSTON AAP	7	2.4
302-BRIDGESTONE/FIRESTONE	5	2.4
118-LAND BETWEEN THE LAKES	18	2.4
416-SUNDQUIST	6	2.0
207-CHEATHAM	5	2.0
305-CORDELL HULL WMA	5	2.0
322-WATTS BAR	5	2.0
303-CATOOSA	56	1.7
320-PRENTICE COOPER	6	1.7
201-AEDC AND WOODS RESERVOIR	14	1.5
314-MT. ROOSEVELT	6	1.5
402-CHEROKEE	53	1.5
403-CHUCK SWAN STATE FOREST	14	1.4
415-ROYAL BLUE	20	1.3
304-CHICKAMAUGA	5	1.0

[a]Hunters were asked to list the public areas they hunted during the 2004-05 season and then rank them in relation to deer hunting on Oak Ridge according to the following scale: 1=worse than Oak Ridge, 2=about the same as Oak Ridge, 3=better than Oak Ridge
[b]Numbers listed beside public areas correspond to coding in the 2004 Tennessee Hunting and Trapping Guide

Table 89. Ratings[a] of private lands hunted (at least 5 hunters reporting) by Oak Ridge WMA hunters during the 2004-05 season.

Private Lands Hunted	n	rating
MAURY	8	2.9
LINCOLN	7	2.7
SMITH	14	2.6
GILES	10	2.6
STEWART	6	2.5
HICKMAN	19	2.4
BLEDSOE	6	2.3
HENRY	6	2.3
PERRY	6	2.3
HAMILTON	8	2.3
COFFEE	5	2.2
WHITE	5	2.2
JACKSON	27	2.2
PUTNAM	6	2.2
HUMPHREYS	7	2.1
HARDIN	8	2.1
RHEA	17	2.1
OVERTON	10	2.1
MACON	12	2.1
JEFFERSON	15	2.1
COCKE	16	2.0
BRADLEY	6	2.0
HOUSTON	5	2.0
MEIGS	23	2.0
HANCOCK	15	1.9
GRAINGER	21	1.9
HAMBLEN	9	1.9
SEVIER	9	1.9
ANDERSON	34	1.9
HAWKINS	34	1.9
JOHNSON	17	1.9
LOUDON	25	1.9
SCOTT	15	1.9
CLAY	7	1.9

Table 89 cont. Ratings[a] of private lands hunted (at least 5 hunters reporting) by Oak Ridge WMA hunters during the 2004-05 season.

Private Lands Hunted	n	rating
ROANE	51	1.8
SULLIVAN	30	1.8
MCMINN	15	1.7
CARTER	22	1.7
KNOX	15	1.7
BLOUNT	16	1.6
CLAIBORNE	12	1.6
MORGAN	26	1.6
GREENE	27	1.6
UNICOI	9	1.6
WASHINGTON	13	1.5
CUMBERLAND	9	1.4
MONROE	14	1.4
CAMPBELL	10	1.4

[a]Hunters were asked to list the private lands they hunted during the 2004-05 season and then rank them in relation to deer hunting on Oak Ridge according to the following scale: 1=worse than Oak Ridge, 2=about the same as Oak Ridge, 3=better than Oak Ridge

Table 90. Ratings[a] of public areas hunted (at least 5 hunters reporting) by Catoosa WMA hunters during the 2004-05 season.

Public Areas Hunted[b]	n	rating
FORT CAMPBELL	11	2.9
118-LAND BETWEEN THE LAKES	14	2.6
316-OAK RIDGE	8	2.5
UNKNOWN	11	2.4
DUCK RIVER	5	2.2
416-SUNDQUIST	6	2.2
403-CHUCK SWAN STATE FOREST	18	2.1
207-CHEATHAM	10	2.1
123-NATCHEZ TRACE	9	2.0
BIG SOUTH FORK	7	2.0
320-PRENTICE COOPER	10	1.9
314-MT. ROOSEVELT	9	1.9
209-EAGLE CREEK	5	1.8
216-LAUREL HILL	5	1.8
415-ROYAL BLUE	19	1.7
305-CORDELL HULL WMA	7	1.7
201-AEDC AND WOODS RESERVOIR	10	1.7
402-CHEROKEE	40	1.4

[a]Hunters were asked to list the public areas they hunted during the 2004-05 season and then rank them in relation to deer hunting on Catoosa according to the following scale: 1=worse than Catoosa, 2=about the same as Catoosa, 3=better than Catoosa

[b]Numbers listed beside public areas correspond to coding in the 2004 Tennessee Hunting and Trapping Guide

Table 91. Ratings[a] of private lands hunted (at least 5 hunters reporting) by Catoosa WMA hunters during the 2004-05 season.

Private Lands Hunted	n	rating
MONTGOMERY	7	3.0
DAVIDSON	5	3.0
HOUSTON	5	2.8
HUMPHREYS	8	2.8
CANNON	6	2.7
MCMINN	21	2.6
MACON	15	2.6
WHITE	15	2.6
GILES	5	2.6
HANCOCK	21	2.4
BEDFORD	7	2.4
COFFEE	7	2.4
WILSON	10	2.4
ROBERTSON	5	2.4
MORGAN	31	2.4
STEWART	13	2.4
DEKALB	8	2.4
RUTHERFORD	8	2.4
MAURY	11	2.4
HICKMAN	17	2.4
SMITH	23	2.3
FRANKLIN	6	2.3
ANDERSON	26	2.3
CUMBERLAND	26	2.3
OVERTON	20	2.3
SCOTT	10	2.3
LOUDON	19	2.3
HAWKINS	25	2.2
ROANE	49	2.2
SULLIVAN	5	2.2
JEFFERSON	17	2.2
MEIGS	16	2.1
BLEDSOE	8	2.1
GRAINGER	17	2.1

Table 91 cont. Ratings[a] of private lands hunted (at least 5 hunters reporting) by Catoosa WMA hunters during the 2004-05 season.

Private Lands Hunted	n	rating
JACKSON	28	2.1
HAMILTON	10	2.1
SEVIER	13	2.1
RHEA	15	2.1
BLOUNT	7	2.0
FENTRESS	7	2.0
PICKETT	6	2.0
CARTER	5	2.0
KNOX	15	1.9
CLAIBORNE	17	1.9
PUTNAM	17	1.9
CLAY	8	1.9
SUMNER	11	1.8
WASHINGTON	5	1.8
CAMPBELL	14	1.8
UNION	12	1.8
MONROE	8	1.8
BRADLEY	7	1.7
JOHNSON	10	1.7
COCKE	9	1.7
GREENE	10	1.4

[a]Hunters were asked to list the private lands they hunted during the 2004-05 season and then rank them in relation to deer hunting on Catoosa according to the following scale: 1=worse than Catoosa, 2=about the same as Catoosa, 3=better than Catoosa

Table 92. Ratings[a] of public areas hunted (at least 5 hunters reporting) by Yuchi Refuge hunters during the 2004-05 season.

Public Areas Hunted[b]	n	rating
FORT CAMPBELL	6	2.5
118-LAND BETWEEN THE LAKES	11	2.0
201-AEDC AND WOODS RESERVOIR	15	1.8
303-CATOOSA	15	1.7
320-PRENTICE COOPER	5	1.2
402-CHEROKEE	26	1.1

[a]Hunters were asked to list the public areas they hunted during the 2004-05 season and then rank them in relation to deer hunting on Yuchi Refuge according to the following scale:
1=worse than Yuchi Refuge, 2=about the same as Yuchi Refuge, 3=better than Yuchi Refuge
[b]Numbers listed beside public areas correspond to coding in the 2004 Tennessee Hunting and Trapping Guide

Table 93. Ratings[a] of private lands hunted (at least 5 hunters reporting) by Yuchi Refuge hunters during the 2004-05 season.

Private Lands Hunted	n	rating
FRANKLIN	6	2.3
STEWART	6	2.2
COCKE	6	2.0
LINCOLN	5	2.0
MEIGS	21	2.0
CUMBERLAND	15	1.9
GILES	14	1.9
WILSON	7	1.9
WHITE	5	1.8
BLEDSOE	14	1.8
RHEA	36	1.8
SEQUATCHIE	8	1.8
BRADLEY	11	1.6
MCMINN	23	1.5
JACKSON	8	1.5
MORGAN	8	1.5
MONROE	6	1.5
LOUDON	7	1.4
ROANE	18	1.3
HAMILTON	20	1.3
GREENE	5	1.2

[a]Hunters were asked to list the private lands they hunted during the 2004-05 season and then rank them in relation to deer hunting on Yuchi Refuge according to the following scale:
1=worse than Yuchi Refuge, 2=about the same as Yuchi Refuge, 3=better than Yuchi Refuge

Table 94. Counties of residence[a] for club hunters surveyed following the 2004-05 season.

Ames Plantation		Jasper Mountain		Myers Cove		Rocky River	
Residence	n	Residence	n	Residence	n	Residence	n
SHELBY	33	HAMILTON	25	HAMILTON	3	HAMILTON	23
TIPTON	5	MARION	19	MARION	2	SEQUATCHIE	10
FAYETTE	3	SEQUATCHIE	3	SEQUATCHIE	2	MARION	6
HARDEMAN	2	MCMINN	2	WARREN	2	WARREN	5
MARSHALL	1	BRADLEY	1	KNOX	1	BRADLEY	4
CHESTER	1	KNOX	1	RHEA	1	GRUNDY	1
MADISON	1	MEIGS	1	WILLIAMSON	1	KNOX	1
MARSHALL, MS	1	POLK	1			MCMINN	1
		JACKSON, AL	1			RHEA	1
						VAN BUREN	1
						WHITE	1

a. Counties of residence are in Tennessee unless otherwise noted.

Table 95. Counties of residence for Oak Ridge WMA hunters surveyed following the 2004-05 season.

Oak Ridge Wildlife Management Area					
Residence	n	Residence	n	Residence	n
KNOX	85	JOHNSON	6	JACKSON	1
ANDERSON	43	SEVIER	6	MARION	1
ROANE	37	BLEDSOE	5	MAURY	1
BLOUNT	30	CLAIBORNE	5	POLK	1
SULLIVAN	28	CUMBERLAND	5	SCOTT	1
GREENE	23	JEFFERSON	5	SMITH	1
WASHINGTON	21	PUTNAM	5	WEAKLEY	1
LOUDON	19	UNICOI	5	WILSON	1
COCKE	15	HARDIN	4		
HAMBLEN	15	MEIGS	3		
MONROE	15	MORGAN	3		
BRADLEY	14	FENTRESS	2		
HAMILTON	14	MACON	2		
CARTER	10	ROBERTSON	2		
HAWKINS	10	WILLIAMSON	2		
MCMINN	10	BEDFORD	1		
UNION	9	CLAY	1		
CAMPBELL	8	COFFEE	1		
RHEA	8	DEKALB	1		
GRAINGER	6	HICKMAN	1		

Table 96. Counties of residence for Catoosa WMA hunters surveyed following the 2004-05 season.

Catoosa Wildlife Management Area							
Residence	n	Residence	n	Residence	n	Residence	n
KNOX	70	CARTER	8	FENTRESS	3	HICKMAN	1
CUMBERLAND	38	CLAIBORNE	8	HANCOCK	3	HUMPHREYS	1
ROANE	33	COFFEE	8	LAWRENCE	3	JACKSON	1
BLOUNT	24	HAWKINS	8	MONTGOMERY	3	LEWIS	1
LOUDON	23	JEFFERSON	8	UNICOI	3	MADISON	1
SEVIER	21	GRAINGER	7	BEDFORD	2	MCNAIRY	1
MCMINN	14	OVERTON	7	BLEDSOE	2	MOORE	1
MORGAN	14	UNION	7	DYER	2	OBION	1
ANDERSON	13	WHITE	6	FRANKLIN	2	SCOTT	1
HAMBLEN	13	WILSON	6	HENDERSON	2	SHELBY	1
PUTNAM	13	DAVIDSON	5	JOHNSON	2	STEWART	1
HAMILTON	12	MACON	5	LINCOLN	2	WILLIAMSON	1
WASHINGTON	11	MAURY	5	MARION	2		
BRADLEY	10	COCKE	4	MARSHALL	2		
CAMPBELL	10	GREENE	4	SMITH	2		
SULLIVAN	10	GRUNDY	4	CANNON	1		
SUMNER	10	MEIGS	4	CARROLL	1		
MONROE	9	POLK	4	CHEATHAM	1		
RHEA	9	ROBERTSON	4	HARDIN	1		
RUTHERFORD	9	WARREN	4	HENRY	1		

Table 97. Counties of residence for Yuchi Refuge hunters surveyed following the 2004-05 season.

Yuchi Refuge at Smith Bend			
Residence	n	Residence	n
RHEA	34	DAVIDSON	1
HAMILTON	28	GILES	1
BRADLEY	23	HAWKINS	1
MONROE	17	SEVIER	1
MCMINN	12	SULLIVAN	1
CUMBERLAND	10		
LOUDON	10		
ROANE	10		
POLK	7		
BLOUNT	6		
GREENE	4		
MEIGS	4		
COCKE	3		
WASHINGTON	3		
CARROLL	2		
CARTER	2		
KNOX	2		
OVERTON	2		
ANDERSON	1		
BLEDSOE	1		

Table 98. Counties of residence for sportsman license holders surveyed following the 2004-05 season.

Sportsman license holders									
Residence	n	Residence	n	Residence	n	Residence	n	Residence	n
HAMILTON	30	OBION	11	WEAKLEY	7	DECATUR	4	SEQUATCHIE	2
KNOX	30	CHEATHAM	10	ANDERSON	6	JOHNSON	4	TROUSDALE	2
SHELBY	30	LAWRENCE	10	HARDIN	6	LEWIS	4	UNICOI	2
DAVIDSON	28	WARREN	10	HENRY	6	SCOTT	4	BLEDSOE	1
SULLIVAN	21	BENTON	9	HUMPHREYS	6	SMITH	4	DEKALB	1
MONTGOMERY	20	CAMPBELL	9	LAUDERDALE	6	WASHINGTON	4	GRUNDY	1
BRADLEY	18	COCKE	8	LOUDON	6	WAYNE	4	HANCOCK	1
DYER	18	COFFEE	8	BEDFORD	5	CANNON	3	HOUSTON	1
WILSON	18	CUMBERLAND	8	FAYETTE	5	CLAY	3	LAKE	1
RUTHERFORD	17	FRANKLIN	8	GILES	5	GRAINGER	3	MCNAIRY	1
GIBSON	16	MONROE	8	HAMBLEN	5	MACON	3	STEWART	1
BLOUNT	15	PUTNAM	8	HAWKINS	5	MARSHALL	3		
ROBERTSON	15	CARROLL	7	HENDERSON	5	MEIGS	3		
WILLIAMSON	14	CARTER	7	HICKMAN	5	OVERTON	3		
SUMNER	13	CLAIBORNE	7	MARION	5	UNION	3		
GREENE	12	HARDEMAN	7	MCMINN	5	WHITE	3		
MAURY	12	JEFFERSON	7	POLK	5	HAYWOOD	2		
SEVIER	12	LINCOLN	7	ROANE	5	JACKSON	2		
DICKSON	11	RHEA	7	CHESTER	4	MORGAN	2		
MADISON	11	TIPTON	7	CROCKETT	4	PERRY	2		

Appendix B: Surveys

2005 Post-Season Deer Hunter Survey Ames Plantation

The University of Tennessee
Department of Forestry, Wildlife & Fisheries

2005 Post-Season Deer Hunter Survey
Ames Plantation Hunting Club

We would appreciate a few minutes of your time to answer this survey. The purpose of this study is to help deer managers do a better job of serving you. You can help by sharing your views with us about deer hunting. Your participation is voluntary and your responses are strictly confidential. The information you provide will not be associated with your name.

Section 1 – General Hunting Questions

1. How many years have you hunted deer? ____ # years

2. Approximately how many days did you hunt deer in Tennessee last season (2004-05)?
___ # days

3. How many deer did you harvest during the 2004-05 hunting season in Tennessee (not including any deer harvested on Ames Plantation)?

____ # of antlered bucks ____ # of does ____ # of fawns ☐ none

4. Do you prefer to shoot antlered bucks, does, or fawns? *(please check only one)*

☐ Antlered bucks ☐ Does ☐ Fawns ☐ No preference

5. In your opinion, is a "quality" buck and a "trophy" buck the same thing?

☐ Yes → **Go to Q5a**
☐ No → **Go to Q5b**

5a. **If yes**, how do you define a quality/trophy buck?

_____
_____

5b. **If no**, how do you define a quality buck?

_____
_____

5c. **If no**, how do you define a trophy buck?

_____
_____

6. How many antlered bucks should be allowed per individual in the Tennessee state bag limit?

____ # of antlered bucks allowed ☐ Don't know

7. Should antler restrictions be implemented **statewide** in Tennessee?

☐ Yes ☐ No ☐ Don't know

Please answer the following questions to help us know <u>what you think</u> about the deer herd in Tennessee.

8. Is genetics a "problem" for the deer herd on many properties in Tennessee?	☐ Yes ☐ No ☐ Don't know	**If yes,** what is the best solution for improving the genetics of the deer herd?
9. Is the deer herd across most of Tennessee overpopulated?	☐ Yes ☐ No ☐ Don't know	**If yes,** how should this be addressed?
10. Is the age structure of the deer herd over most of Tennessee balanced?	☐ Yes ☐ No ☐ Don't know	**If no,** what is the best way to improve the age structure of the deer herd in Tennessee?
11. Is adequate nutrition available to deer over most of Tennessee?	☐ Yes ☐ No ☐ Don't know	**If no,** what is the best way to improve nutrition for deer in Tennessee?

Continue ⇒

12. What influences deer weight most in Tennessee? *(please check one)*

☐ Available food resources ☐ Herd management ☐ Soils

13. How satisfied are you with TWRA's statewide deer management strategy? *(please check one)*

☐ Very dissatisfied
☐ Somewhat dissatisfied
☐ Neither dissatisfied nor satisfied
☐ Somewhat satisfied
☐ Very satisfied

14. Did you hunt white-tailed deer in states other than Tennessee during the 2004-05 season?

☐ Yes ☐ No

14a. **If yes,** please list the states and why you hunted there.

_____
_____
_____
_____

Section 2 – Quality Deer Management
Please let us know your feelings on Quality Deer Management.

15. How would you rate your knowledge of Quality Deer Management? *(please check one)*

☐ Not at all knowledgeable → **Go to Q25**
☐ Somewhat knowledgeable
☐ Very knowledgeable

16. Where possible, do you think Quality Deer Management (QDM) is a sensible management philosophy?

☐ Yes ☐ No ☐ Don't know

17. What do you consider to be the most important **objectives** in a QDM program?

1. _____
2. _____
3. _____

18. Upon initiating a QDM program, how many years do you think it should take before QDM objectives are realized? ____ # years ☐ Don't know

19. What is the primary **benefit** of a QDM program?

_____
_____

20. How old do you think a buck should be before it is "legal" to harvest in a QDM program? *(please check one)*

☐ 2 ½ years ☐ 3 ½ years ☐ 4 ½ years ☐ older than 4 ½

21. What do you think is the **best** antler restriction in a QDM program? *(please check only one)*

☐ Antler point restriction → How many points **on a side**? _____ points
☐ Spread restriction → How much outside spread? _____ inches
☐ Main beam length → How long? _____ inches
☐ Gross score restriction → How many inches Boone and Crockett? _____ inches
☐ Circumference restriction → Minimum measurement _____ inches
☐ Depends on the average characteristics of bucks in that area.
☐ No antler restriction, but impose a 1-buck limit.

22. Which is the most important factor in the success of a QDM program? *(please check one)*

☐ Age ☐ Nutrition ☐ Genetics

23. Do you expect deer, on average, to weigh more on properties managed under QDM guidelines?

☐ Yes ☐ No ☐ Don't know

23a. **If yes,** why?

_____
_____

24. Do you prefer to hunt areas under QDM restrictions?

☐ Yes ☐ No ☐ Don't know

Section 3 – Ames Plantation
Please think about the deer herd and your hunting experiences specifically at **Ames Plantation** during the 2004-05 season when answering the following section.

25. How many years have you hunted deer at Ames Plantation? ____ # years

Continue ⇒

26. Did you hunt deer during the 2004-05 hunting season at Ames Plantation?

☐ Yes → **Go to Q27**
☐ No → **Go to Q28**

27. How many deer did you harvest during the 2004-05 hunting season at Ames Plantation?

____ # of antlered bucks ____ # of does ____ # of fawns ☐ none

28. How many antlered bucks should each individual be allowed to harvest at Ames Plantation?

____ # of antlered bucks allowed ☐ Don't know

29. Do you see fewer, the same, or more antlered bucks at Ames Plantation than on properties managed under traditional deer management guidelines? *(please check one)*

☐ Fewer ☐ Same ☐ More ☐ Don't know

30. Should spikes be killed intentionally (i.e., culled) at Ames Plantation?	☐ Yes ☐ No ☐ Don't know	**Why or why not?**
31. Should older bucks with poor racks be culled at Ames Plantation?	☐ Yes ☐ No ☐ Don't know	**If yes,** what characteristics would you use to recognize these bucks?
32. Is genetics limiting the success of the QDM program at Ames Plantation?	☐ Yes ☐ No ☐ Don't know	**If yes,** what is the best solution for improving the genetics of the deer herd?

33. Are the QDM restrictions at Ames Plantation working toward their goal?

☐ Yes ☐ No ☐ Don't know

34. Is the deer herd at Ames Plantation overpopulated?	☐ Yes ☐ No ☐ Don't know	**If yes,** how should this be addressed?
35. Is the age structure of the deer herd at Ames Plantation balanced?	☐ Yes ☐ No ☐ Don't know	**If no,** what do you think is the best way to improve the age structure of the deer herd at Ames Plantation?
36. Is adequate nutrition available to deer at Ames Plantation?	☐ Yes ☐ No ☐ Don't know	**If no,** what do you think is the best way to improve nutrition for deer at Ames Plantation?

37. Should does be included in the harvest at Ames Plantation?

☐ Yes ☐ No ☐ Don't know

38. What is a desirable buck-to-doe ratio for Ames Plantation?

____ # buck(s) to ____ # doe(s) ☐ Don't know

39. Should buck fawns be "legal for harvest" at Ames Plantation?

☐ Yes ☐ No ☐ Don't know

Continue ⇒

40. Should doe fawns be "legal for harvest" at Ames Plantation?

☐ Yes ☐ No ☐ Don't know

41. People hunt deer for many reasons. Please think about the reasons you hunt deer at Ames Plantation. For the following list of reasons, please indicate *(check)* how important each reason is to you.

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
To shoot deer	☐	☐	☐	☐	☐
To kill a buck with a large rack	☐	☐	☐	☐	☐
A place to hunt	☐	☐	☐	☐	☐
To see lots of deer	☐	☐	☐	☐	☐
Challenge of the hunt	☐	☐	☐	☐	☐
To get venison for food	☐	☐	☐	☐	☐
Social interaction (to be with family or friends)	☐	☐	☐	☐	☐
Deer population reduction	☐	☐	☐	☐	☐
Solitude	☐	☐	☐	☐	☐
Experience nature	☐	☐	☐	☐	☐

41a. Please list any other reason you hunt deer at Ames Plantation.

_____

_____

42. Did you hunt deer on any Wildlife Management Areas (WMAs) during the 2004-05 season?

☐ Yes ☐ No → **Go to Q44**

42a. **If yes**, which ones?

_____

_____

_____

43. What could the Tennessee Wildlife Resources Agency (TWRA) do (or change) to improve deer hunting on these WMAs, if anything?

_____

_____

44. Please list all public areas (other than Ames Plantation) where you have hunted deer in Tennessee during the 2004-05 season (including the WMAs you listed in Q42a).

☐ Didn't hunt other public areas during the 2004-05 season → **Go to Q45**

Public Areas Hunted Deer	**Compared to Ames Plantation, hunting deer at this site is:**		
1. Area _____	☐ Worse	☐ About the same	☐ Better
2. Area _____	☐ Worse	☐ About the same	☐ Better
3. Area _____	☐ Worse	☐ About the same	☐ Better
4. Area _____	☐ Worse	☐ About the same	☐ Better

45. Please list any counties in Tennessee in which you hunted deer on private land during the 2004-05 season. If there are QDM restrictions on that property, please list the restriction.

☐ Didn't hunt on private land during the 2004-05 season → **Go to Q46**

Private Lands Hunted Deer	**Compared to Ames Plantation, hunting deer at this site is:**		
1. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			
2. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			
3. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			
4. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			

Continue ⇒

46. What three things do you like most about deer hunting at Ames Plantation?

1. _____
2. _____
3. _____

47. What three things do you like least about deer hunting at Ames Plantation?

1. _____
2. _____
3. _____

48. How many miles (one-way) do you travel from your home to hunt at Ames Plantation?
_____ # miles

49. Do you plan on hunting deer at Ames Plantation next hunting season?

☐ Yes ☐ No ☐ Don't know

Section 4 – Demographic Questions
Finally, we would like some general information about you to make comparisons among hunters in Tennessee. Remember all information is voluntary and confidential and will not be identified with your name. You may refuse to answer any questions.

50. What is your age? ____

51. Are you ...? ☐ Male ☐ Female

52. Education. *(Please check the highest level completed.)*

☐ Less than high school
☐ High school graduate or GED
☐ Technical or vocational school
☐ Some college
☐ College graduate
☐ Post-graduate
☐ Other (please specify):_____

53. Check the one response that best describes the size of the area where you live.
(please check one)

☐ A Farm
☐ A Rural area, but not a farm
☐ A Town with less than 10,000 people
☐ A City 10,000 to under 50,000 people
☐ A City 50,000 to under 100,000 people
☐ A City with 100,000 people or more

54. Check the category that includes your 2004 Household Income before taxes. *(please check one)*

☐ Under $10,000
☐ $10,000 to $19,999
☐ $20,000 to $29,999
☐ $30,000 to $39,999
☐ $40,000 to $49,999
☐ $50,000 to $74,999
☐ $75,000 to $99,999
☐ $100,000 and above

Thank you for completing this survey!

Please list any additional comments you would like to share about Ames Plantation or Quality Deer Management below.

Please return the questionnaire using the stamped, self-addressed envelope provided to: **Deer Hunter Survey, Department of Forestry, Wildlife and Fisheries-1075, 5723 Middlebrook Pike, Knoxville, TN 37921-9920.**

2005 Post-Season
Deer Hunter Survey
Catoosa Wildlife Management Area

The University of Tennessee
Department of Forestry, Wildlife & Fisheries

2005 Post-Season Deer Hunter Survey
Catoosa Wildlife Management Area

We would appreciate a few minutes of your time to answer this survey. The purpose of this study is to help deer managers do a better job of serving you. You can help by sharing your views with us about deer hunting. Your participation is voluntary and your responses are strictly confidential. The information you provide will not be associated with your name.

Section 1 – General Hunting Questions

1. How many years have you hunted deer? ____ # years

2. Approximately how many days did you hunt deer in Tennessee last season (2004-05)?
___ # days

3. How many deer did you harvest during the 2004-05 hunting season in Tennessee (not including any deer harvested on Catoosa WMA)?

____ # of antlered bucks ____ # of does ____ # of fawns ☐ none

4. Do you prefer to shoot antlered bucks, does, or fawns? *(please check only one)*

☐ Antlered bucks ☐ Does ☐ Fawns ☐ No preference

5. In your opinion, is a "quality" buck and a "trophy" buck the same thing?

☐ Yes → **Go to Q5a**
☐ No → **Go to Q5b**

5a. **If yes**, how do you define a quality/trophy buck?

_____
_____

5b. **If no**, how do you define a quality buck?

_____
_____

5c. **If no**, how do you define a trophy buck?

_____
_____

6. How many antlered bucks should be allowed per individual in the Tennessee state bag limit?

____ # of antlered bucks allowed ☐ Don't know

7. Should antler restrictions be implemented **statewide** in Tennessee?

☐ Yes ☐ No ☐ Don't know

Please answer the following questions to help us know <u>what you think</u> about the deer herd in Tennessee.

8. Is genetics a "problem" for the deer herd on many properties in Tennessee?	☐ Yes ☐ No ☐ Don't know	**If yes,** what is the best solution for improving the genetics of the deer herd?
9. Is the deer herd across most of Tennessee overpopulated?	☐ Yes ☐ No ☐ Don't know	**If yes,** how should this be addressed?
10. Is the age structure of the deer herd over most of Tennessee balanced?	☐ Yes ☐ No ☐ Don't know	**If no,** what is the best way to improve the age structure of the deer herd in Tennessee?
11. Is adequate nutrition available to deer over most of Tennessee?	☐ Yes ☐ No ☐ Don't know	**If no,** what is the best way to improve nutrition for deer in Tennessee?

Continue ⇒

12. What influences deer weight most in Tennessee? *(please check one)*

☐ Available food resources ☐ Herd management ☐ Soils

13. How satisfied are you with TWRA's statewide deer management strategy? *(please check one)*

☐ Very dissatisfied
☐ Somewhat dissatisfied
☐ Neither dissatisfied nor satisfied
☐ Somewhat satisfied
☐ Very satisfied

14. Did you hunt white-tailed deer in states other than Tennessee during the 2004-05 season?

☐ Yes ☐ No

14a. **If yes,** please list the states and why you hunted there.

_____
_____
_____
_____

Section 2 – Quality Deer Management
Please let us know your feelings on Quality Deer Management.

15. How would you rate your knowledge of Quality Deer Management? *(please check one)*

☐ Not at all knowledgeable → **Go to Q25**
☐ Somewhat knowledgeable
☐ Very knowledgeable

16. Where possible, do you think Quality Deer Management (QDM) is a sensible management philosophy?

☐ Yes ☐ No ☐ Don't know

17. What do you consider to be the most important **objectives** in a QDM program?

1. _____
2. _____
3. _____

18. Upon initiating a QDM program, how many years do you think it should take before QDM objectives are realized? ____ # years ☐ Don't know

19. What is the primary **benefit** of a QDM program?

_____
_____

20. How old do you think a buck should be before it is "legal" to harvest in a QDM program? *(please check one)*

☐ 2 ½ years ☐ 3 ½ years ☐ 4 ½ years ☐ older than 4 ½

21. What do you think is the **best** antler restriction in a QDM program? *(please check only one)*

☐ Antler point restriction → How many points **on a side**? _____ points
☐ Spread restriction → How much outside spread? _____ inches
☐ Main beam length → How long? _____ inches
☐ Gross score restriction → How many inches Boone and Crockett? _____ inches
☐ Circumference restriction → Minimum measurement _____ inches
☐ Depends on the average characteristics of bucks in that area.
☐ No antler restriction, but impose a 1-buck limit.

22. Which is the most important factor in the success of a QDM program? *(please check one)*

☐ Age ☐ Nutrition ☐ Genetics

23. Do you expect deer, on average, to weigh more on properties managed under QDM guidelines?

☐ Yes ☐ No ☐ Don't know

23a. **If yes,** why?

_____
_____

24. Do you prefer to hunt areas under QDM restrictions?

☐ Yes ☐ No ☐ Don't know

Section 3 – Catoosa Wildlife Management Area
Please think about the deer herd and your hunting experiences specifically at **Catoosa Wildlife Management Area** during the 2004-05 season when answering the following section.

25. How many years have you hunted deer at Catoosa? ____ # years
(years actually hunted – not years put in for the drawings)

Continue ⇒

26. Did you hunt deer during the 2004-05 hunting season at Catoosa?

☐ Yes → **Go to Q27**
☐ No → **Go to Q28**

27. How many deer did you harvest during the 2004-05 hunting season at Catoosa?

____ # of antlered bucks ____ # of does ____ # of fawns ☐ none

28. How many antlered bucks should each individual be allowed to harvest at Catoosa?

____ # of antlered bucks allowed ☐ Don't know

29. Do you see fewer, the same, or more antlered bucks at Catoosa than on properties managed under traditional deer management guidelines? *(please check one)*

☐ Fewer ☐ Same ☐ More ☐ Don't know

30. Should spikes be killed intentionally (i.e., culled) at Catoosa?	☐ Yes ☐ No ☐ Don't know	**Why or why not?**
31. Should older bucks with poor racks be culled at Catoosa?	☐ Yes ☐ No ☐ Don't know	**If yes,** what characteristics would you use to recognize these bucks?
32. Is genetics limiting the success of the QDM program at Catoosa?	☐ Yes ☐ No ☐ Don't know	**If yes,** what is the best solution for improving the genetics of the deer herd?

33. Are the QDM restrictions at Catoosa working toward their goal?

☐ Yes ☐ No ☐ Don't know

34. Is the deer herd at Catoosa overpopulated?	☐ Yes ☐ No ☐ Don't know	**If yes,** how should this be addressed?
35. Is the age structure of the deer herd at Catoosa balanced?	☐ Yes ☐ No ☐ Don't know	**If no,** what do you think is the best way to improve the age structure of the deer herd at Catoosa?
36. Is adequate nutrition available to deer at Catoosa?	☐ Yes ☐ No ☐ Don't know	**If no,** what do you think is the best way to improve nutrition for deer at Catoosa?

37. Should does be included in the harvest at Catoosa?

☐ Yes ☐ No ☐ Don't know

38. What is a desirable buck-to-doe ratio for Catoosa?

____ # buck(s) to ____ # doe(s) ☐ Don't know

39. Should buck fawns be "legal for harvest" at Catoosa?

☐ Yes ☐ No ☐ Don't know

Continue ⇒

40. Should doe fawns be "legal for harvest" at Catoosa?

☐ Yes ☐ No ☐ Don't know

41. People hunt deer for many reasons. Please think about the reasons you hunt deer at Catoosa. For the following list of reasons, please indicate *(check)* how important each reason is to you.

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
To shoot deer	☐	☐	☐	☐	☐
To kill a buck with a large rack	☐	☐	☐	☐	☐
A place to hunt	☐	☐	☐	☐	☐
To see lots of deer	☐	☐	☐	☐	☐
Challenge of the hunt	☐	☐	☐	☐	☐
To get venison for food	☐	☐	☐	☐	☐
Social interaction (to be with family or friends)	☐	☐	☐	☐	☐
Deer population reduction	☐	☐	☐	☐	☐
Solitude	☐	☐	☐	☐	☐
Experience nature	☐	☐	☐	☐	☐

41a. Please list any other reason you hunt deer at Catoosa.

_____

_____

42. What could the Tennessee Wildlife Resources Agency (TWRA) do (or change) to improve deer hunting on Catoosa, if anything?

_____

_____

43. Did you hunt deer on any other Wildlife Management Areas (WMAs) during the 2004-05 season?

☐ Yes ☐ No → Go to Q44

43a. If yes, which ones?

_____

_____

_____

44. Please list all public areas (other than Catoosa) where you have hunted deer in Tennessee during the 2004-05 season (including the WMAs you listed in Q43a).

☐ Didn't hunt other public areas during the 2004-05 season → Go to Q45

Public Areas Hunted Deer	Compared to Catoosa, hunting deer at this site is:		
1. Area _____	☐ Worse	☐ About the same	☐ Better
2. Area _____	☐ Worse	☐ About the same	☐ Better
3. Area _____	☐ Worse	☐ About the same	☐ Better
4. Area _____	☐ Worse	☐ About the same	☐ Better

45. Please list any counties in Tennessee in which you hunted deer on private land during the 2004-05 season. If there are QDM restrictions on that property, please list the restriction.

☐ Didn't hunt on private land during the 2004-05 season → Go to Q46

Private Lands Hunted Deer	Compared to Catoosa, hunting deer at this site is:		
1. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			
2. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			
3. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			
4. County _____	☐ Worse	☐ About the same	☐ Better
☐ No QDM ☐ Yes → QDM Restriction: _____			

Continue ⇒

46. What three things do you like most about deer hunting at Catoosa?

1. _____
2. _____
3. _____

47. What three things do you like least about deer hunting at Catoosa?

1. _____
2. _____
3. _____

48. How many miles (one-way) do you travel from your home to hunt at Catoosa? _____ # miles

49. Do you plan on applying to hunt deer at Catoosa next hunting season?

☐ Yes ☐ No ☐ Don't know

Section 4 – Demographic Questions

Finally, we would like some general information about you to make comparisons among hunters in Tennessee. Remember all information is voluntary and confidential and will not be identified with your name. You may refuse to answer any questions.

50. What is your age? ____

51. Are you …? ☐ Male ☐ Female

52. Education. *(Please check the highest level completed.)*

☐ Less than high school
☐ High school graduate or GED
☐ Technical or vocational school
☐ Some college
☐ College graduate
☐ Post-graduate
☐ Other (please specify):_____

53. Check the one response that best describes the size of the area where you live. *(please check one)*

☐ A Farm
☐ A Rural area, but not a farm
☐ A Town with less than 10,000 people
☐ A City 10,000 to under 50,000 people
☐ A City 50,000 to under 100,000 people
☐ A City with 100,000 people or more

54. Check the category that includes your 2004 Household Income before taxes. *(please check one)*

☐ Under $10,000
☐ $10,000 to $19,999
☐ $20,000 to $29,999
☐ $30,000 to $39,999
☐ $40,000 to $49,999
☐ $50,000 to $74,999
☐ $75,000 to $99,999
☐ $100,000 and above

Thank you for completing this survey!

Please list any additional comments you would like to share about Catoosa WMA or Quality Deer Management below.

Please return the questionnaire using the stamped, self-addressed envelope provided to: **Deer Hunter Survey, Department of Forestry, Wildlife and Fisheries-1075, 5723 Middlebrook Pike, Knoxville, TN 37921-9920.**

2005 Post-Season
Deer Hunter Survey

The University of Tennessee
Department of Forestry, Wildlife & Fisheries

2005 Post-Season Deer Hunter Survey
Tennessee Statewide Sportsman

We would appreciate a few minutes of your time to answer this survey. The purpose of this study is to help deer managers do a better job of serving you. You can help by sharing your views with us about deer hunting. Your participation is voluntary and your responses are strictly confidential. The information you provide will not be associated with your name.

Section 1 – General Hunting Questions

1. Do you hunt white-tailed deer in Tennessee? *(please check one)*

   ☐ Yes → **Go to Q2**
   ☐ No → **Thank you for your time. Please return the survey in the envelope provided.**

2. How many years have you hunted deer? ____ # years

3. Approximately how many days did you hunt deer in Tennessee last season (2004-05)?
   ____ # days

4. How many deer did you harvest during the 2004-05 hunting season in Tennessee?

   ____ # of antlered bucks ____ # of does ____ # of fawns ☐ none

5. Do you prefer to shoot antlered bucks, does, or fawns? *(please check only one)*

   ☐ Antlered bucks ☐ Does ☐ Fawns ☐ No preference

6. In your opinion, is a "quality" buck and a "trophy" buck the same thing?

   ☐ Yes → **Go to Q6a**
   ☐ No → **Go to Q6b**

   6a. **If yes**, how do you define a quality/trophy buck?

   _____
   _____

   6b. **If no**, how do you define a quality buck?

   _____
   _____

   6c. **If no**, how do you define a trophy buck?

   _____
   _____

7. How many antlered bucks should be allowed per individual in the Tennessee state bag limit?

   ____ # of antlered bucks allowed ☐ Don't know

8. Should antler restrictions be implemented **statewide** in Tennessee?

   ☐ Yes ☐ No ☐ Don't know

Please answer the following questions to help us know <u>what you think</u> about the deer herd in Tennessee.

9. Is genetics a "problem" for the deer herd on many properties in Tennessee?	☐ Yes ☐ No ☐ Don't know	**If yes,** what is the best solution for improving the genetics of the deer herd?
10. Is the deer herd across most of Tennessee overpopulated?	☐ Yes ☐ No ☐ Don't know	**If yes,** how should this be addressed?

Continue ⇒

11. Is the age structure of the deer herd over most of Tennessee balanced?	☐ Yes ☐ No ☐ Don't know	**If no,** what is the best way to improve the age structure of the deer herd in Tennessee?
12. Is adequate nutrition available to deer over most of Tennessee?	☐ Yes ☐ No ☐ Don't know	**If no,** what is the best way to improve nutrition for deer in Tennessee?

13. What influences deer weight most in Tennessee? *(please check one)*

☐ Available food resources ☐ Herd management ☐ Soils

14. How satisfied are you with TWRA's statewide deer management strategy? *(please check one)*

☐ Very dissatisfied
☐ Somewhat dissatisfied
☐ Neither dissatisfied nor satisfied
☐ Somewhat satisfied
☐ Very satisfied

15. Did you hunt white-tailed deer in states other than Tennessee during the 2004-05 season?

☐ Yes ☐ No

15a. **If yes,** please list the states and why you hunted there.

_____
_____
_____
_____

Section 2 – Quality Deer Management

Please let us know your feelings on Quality Deer Management.

16. How would you rate your knowledge of Quality Deer Management? *(please check one)*

☐ Not at all knowledgeable → **Go to Q32**
☐ Somewhat knowledgeable
☐ Very knowledgeable

17. Where possible, do you think Quality Deer Management (QDM) is a sensible management philosophy?

☐ Yes ☐ No ☐ Don't know

18. What do you consider to be the most important **objectives** in a QDM program?

1. _____
2. _____
3. _____

19. Upon initiating a QDM program, how many years do you think it should take before QDM objectives are realized? ____ # years ☐ Don't know

20. What is the primary **benefit** of a QDM program?

_____
_____

21. How old do you think a buck should be before it is "legal" to harvest in a QDM program? *(please check one)*

☐ 2 ½ years ☐ 3 ½ years ☐ 4 ½ years ☐ older than 4 ½

Continue ⇒

22. What do you think is the **best** antler restriction in a QDM program? *(please check only one)*

- ☐ Antler point restriction → How many points **on a side**? _____ points
- ☐ Spread restriction → How much outside spread? _____ inches
- ☐ Main beam length → How long? _____ inches
- ☐ Gross score restriction → How many inches Boone and Crockett? _____ inches
- ☐ Circumference restriction → Minimum measurement _____ inches
- ☐ Depends on the average characteristics of bucks in that area.
- ☐ No antler restriction, but impose a 1-buck limit.

23. Which is the most important factor in the success of a QDM program? *(please check one)*

☐ Age ☐ Nutrition ☐ Genetics

24. Do you expect deer, on average, to weigh more on properties managed under QDM guidelines?

☐ Yes ☐ No ☐ Don't know

24a. **If yes,** why?

_____

_____

25. Do you prefer to hunt areas under QDM restrictions?

☐ Yes ☐ No ☐ Don't know

26. Should spikes be killed intentionally (i.e., culled) in a QDM program?	☐ Yes ☐ No ☐ Don't know	**Why or why not?**
27. Should older bucks with poor racks be culled in a QDM program?	☐ Yes ☐ No ☐ Don't know	**If yes,** what characteristics would you use to recognize these bucks?

28. Should does be included in the harvest in a QDM program?

☐ Yes ☐ No ☐ Don't know

29. What is a desirable buck-to-doe ratio for a QDM program?

____ # buck(s) to ____ # doe(s) ☐ Don't know

30. Should buck fawns be "legal for harvest" in a QDM program?

☐ Yes ☐ No ☐ Don't know

31. Should doe fawns be "legal for harvest" in a QDM program?

☐ Yes ☐ No ☐ Don't know

Continue ⇒

32. People hunt deer for many reasons. Please think about the reasons you hunt deer. For the following list of reasons, please indicate (*check*) how important each reason is to you.

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
To shoot deer	☐	☐	☐	☐	☐
To kill a buck with a large rack	☐	☐	☐	☐	☐
To see lots of deer	☐	☐	☐	☐	☐
Challenge of the hunt	☐	☐	☐	☐	☐
To get venison for food	☐	☐	☐	☐	☐
Social interaction (to be with family or friends)	☐	☐	☐	☐	☐
Deer population reduction	☐	☐	☐	☐	☐
Solitude	☐	☐	☐	☐	☐
Experience nature	☐	☐	☐	☐	☐

32a. Please list any other reason you hunt deer.

_____

_____

33. Did you hunt deer on any Wildlife Management Areas (WMAs) during the 2004-05 season?

☐ Yes ☐ No → **Go to Q35**

33a. **If yes**, which ones?

_____

_____

_____

34. What could the Tennessee Wildlife Resources Agency (TWRA) do (or change) to improve deer hunting on these WMAs, if anything?

_____

_____

35. Please list all public areas where you have hunted deer in Tennessee during the 2004-05 season (including the WMAs you listed in Q33a).

☐ Didn't hunt other public areas during the 2004-05 season → **Go to Q36**

Public Areas Hunted Deer

1. Area _____
2. Area _____
3. Area _____
4. Area _____

36. Please list any counties in Tennessee in which you hunted deer on private land during the 2004-05 season. If there are QDM restrictions on that property, please list the restriction.

☐ Didn't hunt on private land during the 2004-05 season → **Go to Q37**

Private Lands Hunted Deer **Is there a QDM restriction on that property?**

County _____ ☐ Yes ☐ No ☐ Don't know

QDM restriction _____

County _____ ☐ Yes ☐ No ☐ Don't know

QDM restriction _____

County _____ ☐ Yes ☐ No ☐ Don't know

QDM restriction _____

County _____ ☐ Yes ☐ No ☐ Don't know

QDM restriction _____

Continue ⇒

37. In terms of maximum distance, how much further would you be willing to drive, if any, to hunt a QDM area versus a non-QDM area?

- ☐ No further
- ☐ 25 miles or less
- ☐ 26 – 50 miles
- ☐ 51 – 75 miles
- ☐ 76 – 100 miles
- ☐ 101 – 125 miles
- ☐ 126 – 150 miles
- ☐ 151 – 175 miles
- ☐ 176 – 200 miles
- ☐ More than 200 miles

Section 3 – Demographic Questions

Finally, we would like some general information about you to make comparisons among hunters in Tennessee. Remember all information is voluntary and confidential and will not be identified with your name. You may refuse to answer any questions.

38. What is your age? ____

39. Are you ...? ☐ Male ☐ Female

40. Education. *(Please check the highest level completed.)*

- ☐ Less than high school
- ☐ High school graduate or GED
- ☐ Technical or vocational school
- ☐ Some college
- ☐ College graduate
- ☐ Post-graduate
- ☐ Other (please specify):_____

41. Check the one response that best describes the size of the area where you live. *(please check one)*

- ☐ A Farm
- ☐ A Rural area, but not a farm
- ☐ A Town with less than 10,000 people
- ☐ A City 10,000 to under 50,000 people
- ☐ A City 50,000 to under 100,000 people
- ☐ A City with 100,000 people or more

42. Check the category that includes your 2004 Household Income before taxes. *(please check one)*

- ☐ Under $10,000
- ☐ $10,000 to $19,999
- ☐ $20,000 to $29,999
- ☐ $30,000 to $39,999
- ☐ $40,000 to $49,999
- ☐ $50,000 to $74,999
- ☐ $75,000 to $99,999
- ☐ $100,000 and above

Thank you for completing this survey!

Please list any additional comments you would like to share about deer hunting or Quality Deer Management below.

Please return the questionnaire using the stamped, self-addressed envelope provided to: **Deer Hunter Survey, Department of Forestry, Wildlife and Fisheries-1075, 5723 Middlebrook Pike, Knoxville, TN 37921-9920.**

VITA

Christopher Edward Shaw was born in Greeneville, TN, on August 26, 1981. He was raised on a farm in Limestone, TN, and graduated from Daniel Boone High School in 1999. He attended Walters State Community College and received an Associate of Science Degree in Agriculture in 2001. After graduating summa cum laude with a Bachelor of Science Degree in Wildlife and Fisheries Science at the University of Tennessee in 2003, he worked as a wildlife technician at Ames Plantation. During the summer of 2004, he started work toward a Master of Science Degree in Wildlife and Fisheries at UT. Upon completion of the degree in 2008, Chris will seek employment as a wildlife biologist or manager in east Tennessee.